Technical Background Document

Proposed Exclusions from the Definition of Hazardous Waste and Solid Waste for Solvent-Contaminated Industrial Wipes

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Contents

ACRONYMS

Acronym	Definition
APA	Administrative Procedures Act
.....	Association of State and Territorial Solid Waste
ASTSWMO.....	Management Officials
...	Alliance of Textile Care Associations
	Boiler or Industrial Furnace
ATCA.....	Biennial Report System
...	Clean Air Act
BIF.....	Chemical Abstracts Service Registry Number
..	Confidential Business Information
BRS.....	Conditionally Exempt Small Quantity Generator
...	Code of Federal Regulations
CAA.....	Cancer Slope Factor
..	Common Sense Initiative
CAS	Clean Water Act
No.....	Dilution Attenuation Factor
CBI.....	Department of Transportation
...	Domestic Sewage Study
CESQG.....	Effluent Limitation Guidelines
..	Environmental Protection Agency
CFR.....	Federal Register
...	Hazardous Air Pollutants
CSF.....	Hazard Communication Standard
..	Hazardous and Solid Waste Amendments
CSI.....	Hazard Quotient
..	Hazardous Waste Combustor
CWA.....	Information Collection Request
..	Integrated Risk Information System
DAF.....	Integrated Waste Services Association
...	Land Disposal Restrictions
DOT.....	Large Quantity Generator
..	Maximum Achievable Control Technology
DSS.....	Methyl Isobutyl Ketone
..	Material Data Safety Sheet
ELG.....	Municipal Solid Waste
...	Municipal Solid Waste Landfill
EPA.....	Municipal Waste Combustor
...FR.....	National Ambient Air Quality Standards
.....	National Emission Standards for Hazardous Air
HAP.....	Pollutants
...	National Fire Incident Reporting System
HCS.....	National Pollution Discharge Elimination System
...	Natural Resources Defense Council
HSWA.....	
...	
HQ.....	
...	
HWC.....	
..	

Acronym	Definition
NSPS	New Source Performance Standards
NTTAA	National Technology Transfer and Advancement Act
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OPPE	Office of Policy, Planning and Evaluation
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
PBMS	Performance Based Measurement System
PCB	Polychlorinated Biphenyls
POTW	Publicly Owned Treatment Works
RCRA	Resource Conservation and Recovery Act
RFA	Regulatory Flexibility Act
RfC	Reference Air Concentrations
RfD	Reference Doses for Exposure through Ingestion
RIC	RCRA Information Center
SBREFA	Small Business Regulatory Enforcement Fairness Act
SIC	Standard Industry Code
SQG	Small Quantity Generator
TC	Toxicity Characteristic
TCLP	Toxicity Characteristic Leaching Procedure
TBD	Technical Background Document
TDD	Telecommunications Device for the Deaf
UMRA	Unfunded Mandates Reform Act
URF	Unit Risk Factor
USFA	United States Fire Administration
VOC	Volatile Organic Compound

Technical Background Document for Proposed Rule to Conditionally Exclude Solvent-Contaminated Industrial Wipes from the Definition od Hazardous Waste and the Definition of Solid Waste

I. Statement of Problem

I.A. *Background*

The Environmental Protection Agency (EPA) is proposing to amend its regulations under the Resource Conservation and Recovery Act (RCRA). The proposal is (1) to conditionally exclude from the definition of hazardous waste disposable industrial wipes that are contaminated with hazardous solvents and are going to disposal, and (2) to conditionally exclude from the definition of solid waste reusable industrial shop towels and rags that are contaminated with hazardous solvents and are sent for laundering or dry cleaning. The affected universe of waste for this proposed rule encompasses disposable and reusable industrial wipes (e.g., towels, wipes, rags) that industry uses to clean surfaces, parts, accessories, and equipment in conjunction with solvents that when spent are hazardous wastes. Industrial wipes are distinguished by their respective make-up, durability, uses, and disposal method. Once industrial wipes are used and are no longer suitable for their intended purpose, they become solid wastes and potentially hazardous wastes, depending upon the type of solvent used in conjunction with the wipes.

Many solvents used by industry can pose unacceptable risks to human health and the environment if improperly managed. The proposed conditional exclusions will apply to (1) industrial wipes contaminated with solvents that exhibit a hazardous characteristic (i.e.,

ignitability, corrosivity, reactivity, or toxicity) and (2) industrial wipes contaminated with F001-F005 spent F-listed solvents or comparable P- and U-listed commercial chemical products that are spilled and cleaned up with industrial wipes.

Essentially, EPA is proposing to exclude industrial wipes contaminated with solvents that are determined to be a hazardous waste from RCRA subtitle C regulations. The exclusions would be applicable only when specified conditions are met. This proposal responds to two manufacturer petitions as well as requests for regulatory clarification from the user community, particularly from industry representatives in EPA's Printing Common Sense Initiative (CSI).

I.A.1. *Descriptions and Definitions of Affected Wastes*

For purposes of this document and the Agency's proposed rule, we will use the term "industrial wipes" to refer to the following types of wipes and cloths:

An *industrial shop towel* is a woven textile consisting of cotton or polyester blends. These materials are reusable items and are primarily laundered or dry cleaned a number of times before they have outlived their useful life and must be discarded. Shop towels are rented by industrial laundries to manufacturing, automotive, chemical, and other similar facilities to use for heavy-duty cleaning and wiping. Soiled shop towels are either washed or dry cleaned at commercial laundry facilities.

An *industrial wipe* is a non-woven towel consisting of wood pulp, polyester blends or 100 percent polypropylene. These materials come in all sizes and thicknesses. They generally are designed for one-time use and are used to wipe small quantities of solvents off hands, tools, equipment, or floors.

An *industrial rag* is a non-homogeneous material consisting of cotton or polyester blends. Rags are made from old clothing or from cloth remnants from textile mills, and vary in size and type of fabric.

Paper towels also are sometimes used in conjunction with solvents in the workplace. These materials are made from wood pulp with binders.

I.A.2. *Description of Affected Universe*

When investigating current management practices for solvent-contaminated industrial wipes, EPA found tremendous variability in the uses of industrial wipes and their management across and within industries. A wide range of industries and a large number of firms use significant amounts of solvents on industrial wipes and could be eligible for and subject to the conditions of the proposed exclusions. Some of these industrial sectors include printing manufacturing; industrial laundries; automobile repair and maintenance; aircraft manufacturing and maintenance, circuit board manufacturing; furniture manufacturing; and coating and adhesive testing and production. These industries use a range of solvents and varying types of industrial wipes at their facilities. Chapter II of this document summarizes the Agency's current information on the types of establishments that use reusable or disposable industrial wipes in conjunction with solvents.

The types of facilities visited during the data gathering efforts of this proposed rule included printing (flexographic and screen printing), automobile body repair, aircraft manufacturing and maintenance, circuit board manufacturing, and coating and adhesive testing and production. Other industrial sectors that use significant quantities of solvents in conjunction with industrial wipes include furniture manufacturing and automobile manufacturing and maintenance. From site visits conducted at 17 facilities, including nine sites where data was collected, EPA determined the following:

- The RCRA regulatory status of facilities visited included small quantity generators (SQGs) and large quantity generators (LQGs). In some cases, solvent-contaminated industrial wipes appeared to be the primary basis for a facility being classified as an SQG rather than a Conditioanlly Exempt Small Quantity Generator (CESQG).

- Reusable industrial wipes, disposable paper and disposable cloth wipes all were found to be used in the site visits; sometimes firms used both reusable shop towels and disposable industrial wipes in their operations.

- Approximately half the facilities visited reported using their wipes more than once before discarding and sending them for off-site management.

- The amount of solvent placed on individual wipes varied from very small amounts (a fraction of shop towel/wipe weight) to multiples of the wipe's weight.

- Reusable and disposable industrial wipes were managed off-site at hazardous waste treatment (incineration) facilities, fuel blending/burning for energy recovery facilities, and disposal facilities, as well as municipal landfills, industrial landfills and industrial laundries.

- Storage of spent reusable and disposable industrial wipes occurred in either RCRA-compliant covered storage containers, open containers, porous bags or on shelves.

- Advanced solvent-extraction technologies EPA observed included centrifugation, mechanical wringing and use of screen-bottom drums. These technologies are used by generators to remove solvent primarily from reusable industrial wipes (but are also used with disposable industrial wipes) to ensure that free liquids are not sent off-site to an industrial laundry, as well as to assist industrial laundries in meeting their permit conditions from the local POTW.

- Most of the facilities visited had state or county air permits.

I.B. *Overview of Current Regulations*

The applicability of the RCRA hazardous waste management standards to solvent-contaminated industrial wipes has been the subject of changing regulatory interpretations.

I.B.1. *Current Federal Regulations*

Under the federal RCRA program, a solid waste is a hazardous waste if it

(a) is listed as a hazardous waste in 40 CFR Part 261, subpart D;
(b) exhibits one or more of the characteristics of hazardous waste identified in 40 CFR Part 261, subpart C;
(c) is a mixture of a solid waste and a hazardous waste that is listed in subpart D; or
(d) is a mixture of a solid waste and a characteristic hazardous waste (or a listed hazardous waste that is listed solely because it exhibits one or more of the characteristics of hazardous waste identified in Part 261 subpart C), unless the resultant mixture no longer exhibits any characteristic of hazardous waste identified in subpart C (See 40 CFR 261.3(a)(2)).

Therefore, solvent-contaminated industrial wipes meet the definition of hazardous waste due to the applicability of the hazardous waste mixture rule or because they exhibit a characteristic of hazardous waste. The current federal policy is to defer the determination of whether solvent-contaminated industrial wipes must be managed as a solid or hazardous waste to the regional EPA offices and state agencies due to case-specific circumstances (e.g., type of solvent used, degree of hazard, when a spent solvent is generated, and whether the hazardous waste mixture rule applies to a particular waste). The federal policy deferring the regulatory determination for solvent-contaminated industrial wipes was first articulated in a January 23, 1991 letter from Sylvia K. Lowrance, Director, Office of Solid Waste, to Lance R. Miller, Director of New Jersey's Hazardous Waste Management Division. Ms. Lowrance responded to a petition from Kimberly-Clark Corporation and Scott Paper Company, stating that until EPA could make a "more comprehensive interpretation in this rulemaking context [solvent-contaminated industrial wipes]…Regions and States [should] continue to use the current case-by-case approach on this subject." This policy was reaffirmed in a February 14, 1994 memorandum to the EPA Regional Waste Management Directors from Michael Shapiro, Director, Office of Solid Waste.

A majority of states have developed their own policies governing the management of solvent-contaminated industrial wipes (pending EPA action). However, a few states have deferred regulatory decisions regarding the management of solvent-contaminated industrial wipes to their respective EPA regional offices.

I.B.2. *State Regulations*

The majority of states have developed management requirements for solvent-contaminated industrial wipes; the remaining states have deferred such decisions to their EPA regions. A review of state policies regarding the regulation of solvent-contaminated industrial wipes indicates that most states have similar management requirements in place. The majority of states have policies that generally apply the hazardous waste mixture rule to disposable industrial wipes that are contaminated with hazardous waste solvents.

Currently, all states regulate industrial wipes as a hazardous waste when they are contaminated with a listed solvent or exhibit a hazardous waste characteristic and are destined for disposal. Forty-six states provide regulatory relief for solvent-contaminated shop towels that are

sent to an industrial laundry and subsequently reused. The remaining four states (Hawaii, Idaho, New Mexico and South Dakota) regulate reusable solvent-contaminated shop towels as hazardous waste if they contain a listed hazardous waste or exhibit a hazardous waste characteristic, regardless of whether the towels are being laundered.

The majority of state programs consider laundering to be a form of recycling and subsequently exempt reusable shop towels from RCRA regulation. Other states provide conditional exclusions from the hazardous waste regulations for laundered shop towels. In either case, the contaminated shop towels only are exempt from regulation if the following criteria are met:

- the towels/wipes do not contain free liquids; and
- the industrial laundry discharges to a publicly owned treatment works (POTW) or is otherwise permitted under the Clean Water Act.

Some states allow on-site laundering of solvent-contaminated shop towels by generators, provided that there is an agreement on file with the state agency that allows the facility to discharge to the sanitary sewer. In addition, at least three states require contractual agreements between generators and laundries for the generator to qualify for an exemption from RCRA regulation. In most cases, state and regional policies and regulatory programs differentiate between reusable and disposable industrial cloths when determining regulatory status.

While the majority of state policies include the above-mentioned policies and regulatory components, there are some notable variations such as Hawaii, New Mexico, Idaho, and South Dakota. In Hawaii, solvent-contaminated industrial wipes must be managed as hazardous waste up until the point at which they are laundered. Industrial laundries in New Mexico are subject to permitting requirements unless the towels are placed directly into the laundry process (i.e., within 24 hours). In Idaho, industrial wipes must be managed as hazardous waste if they are contaminated with a listed waste or exhibit a characteristic. Reusable towels cannot be laundered unless they are treated to meet the specified LDR treatment standard for the wastes with which they are contaminated. Finally, South Dakota requires that if a listed solvent is applied to a part and then cleaned off with a wipe, the wipe is considered to be a listed hazardous waste (because the solvent is "spent"), must be managed as a hazardous waste, and cannot be laundered. Similarly, if the solvent-contaminated industrial wipe exhibits a characteristic, the material is hazardous and cannot be laundered. However, if the wipe is contaminated with a listed solvent that was applied directly to the wipe, the wipe is not considered to meet a hazardous waste listing description and can be laundered without being managed as a hazardous waste. A more detailed discussion of state regulatory programs governing solvent-contaminated industrial wipes is provided in section III.

I.C. *Scope of Wastes Included in Proposed Rule*

The scope of the proposed rulemaking includes the universe of contaminated industrial wipes being sent to both landfill and non-landfill (e.g., laundries and combustion) facilities and is applicable to industrial wipes (1) contaminated with solvents that exhibit a hazardous characteristic and (2) contaminated with F001-F005 spent F-listed hazardous waste solvents or comparable P- or U-listed commercial chemical products when spilled and cleaned up with

industrial wipes.

I.D. *Rationale for Proposed Rule*

I.D.1. *Current Regulatory Program Based upon Policy/Regulatory Interpretation*

For several years, industry, particularly the disposable industrial wipes industry, requested that EPA address the issue of whether the current federal rules are over-regulating the management of solvent-contaminated industrial wipes that are disposed. More specifically, industry has expressed concern that often only small amounts of solvent are applied to a wipe, and, therefore, by the time the wipe is disposed, little or no risks to human health and the environment exist from management of the wipe because little solvent remains on the wipe. However, as described above, these wipes may be regulated as a hazardous waste because they contain a listed hazardous solvent. Under their own policies, most states subject disposable industrial wipes contaminated with hazardous waste solvents to the hazardous waste mixture rule and require that they be managed as hazardous waste if the mixture is defined under RCRA as a hazardous waste.

The feedback that EPA received on this issue as part of regulatory reform outreach efforts and from industry representatives in the Printing CSI encourages the Agency to address the regulatory status of solvent-contaminated industrial wipes within the context of the federal RCRA program, and to determine whether changes in the federal regulatory program governing the management of these materials are appropriate.

EPA framed its study of solvent-contaminated industrial wipes to answer the following questions and to develop a proposed regulation that would address the issues raised by stakeholders. The primary concern was whether EPA and the states are regulating disposable and reusable industrial wipes effectively to ensure protection of human health and the environment. The following questions were integral to the development of the proposed rulemaking:

- Are solvent-contaminated industrial wipes over-regulated in some cases?
- How can EPA improve on current regulations and policies affecting solvent-contaminated industrial wipes?
- What environmental policies does EPA want to pursue to derive better waste management and environmental results for solvent-contaminated industrial wipes?

I.D.2. *Petitions*

In 1985, Kimberly-Clark Corporation filed a petition with EPA requesting that the Agency exclude disposable solvent-contaminated industrial wipes from regulation as a hazardous waste under subtitle C of RCRA. Kimberly Clark and Scott Paper Company submitted data to EPA to help support a conclusion that little risk to human health and the environment exists from the disposal of solvent-contaminated industrial wipes. Kimberly-Clark asserted the following in its petition:

> *Disposable industrial wipes contaminated with certain solvents listed in Subpart D of Part 261 may be considered a hazardous waste pursuant to the mixture rule (See 40 CFR*

261.3(a) (2) (iv).... Kimberly-Clark believes that solvent-contaminated disposable industrial wipes do not present any meaningful environmental hazards when disposed of as part of the regular, non-hazardous solid waste stream. Indeed, we believe that subjecting such contaminated disposable industrial wipes to regulation as a hazardous waste would [not] result in increased environmental hazard. Therefore, we believe that disposable industrial wipes contaminated with solvents need not and should not be regulated as a hazardous waste.

In addition, to support its petition, Kimberly-Clark made four main points:

(1) The amount of solvent contained in disposable solvent-contaminated industrial wipes is insignificant. The petition estimated that the amount of solvent contained in the wipes represented less than .032 percent (7.1 million pounds or approximately 1 million gallons) of the total volume of solvent waste disposed annually;

(2) Virtually no solvent would be added to subtitle D landfills as a result of an exclusion;

(3) Solvent-contaminated industrial wipes do not exhibit any of the characteristics of hazardous waste; and

(4) Disposable solvent-contaminated industrial wipes are not capable of posing a substantial present or potential hazard to human health and the environment even if improperly managed because the small quantity of solvent contained in disposable wipes that are contaminated as a result of normal use is likely to evaporate before disposal in a landfill Therefore, disposable wipes pose no threat to groundwater. In addition no damage cases have been reported from improper handling of these materials.

A second petition was submitted to EPA by Scott Paper Company, another manufacturer of disposable wipes, on May 27, 1987. Scott Paper's petition made virtually all of the same points as Kimberly-Clark with the following additions:

(1) The commercial disposable wipe market consists of about ten million cases of wipes per year used by approximately one million businesses;

(2) In a typical commercial establishment, soiled wipes comprise approximately one percent of the total annual solid waste stream and that only a small percentage of soiled wipes are contaminated with hazardous waste;

(3) The principal methods of disposal include incineration and land disposal. Because wipes are made of cellulosic material (i.e., wood fiber), they contribute significant heat value and therefore are frequently incinerated. The petition states, "a modern incinerator tends to destroy the material held by the disposable wipe. Incineration is an excellent treatment for destroying cellulosic towels and solvents and such wastes are beneficial to the operation of incinerators;"

(4) Contaminated disposable wipes are handled in a manner that prevents release of hazardous waste to the environment. They are stored for short periods, are picked up regularly by solid waste transporters, are transported relatively short distances (i.e., 50 miles or less), and are

disposed quickly.

A third petition was submitted to EPA by the now-defunct Alliance of Textile Care Associations (ATCA), on March 10, 1987. ATCA also requested an exclusion from RCRA regulation and emphasized that its member companies recycle their solvent-contaminated textiles through laundering or dry cleaning. These soiled textiles are typically accumulated by generators in 55-gallon drums; the drums are picked up weekly by laundry service trucks and transported relatively short distances to the laundry or dry cleaning facilities; the textiles are held (stored) for only short periods of time (48 hours) before cleaning; and after cleaning, the textiles are returned to the client for reuse. In 2000, the Uniform Textile Services Association, formerly a member of ATCA, requested EPA to remove this petition from consideration.

I.D.3. *Risks/Damages*

I.D.3.a. Risk Analyses

Prior to developing the proposed rule for solvent-contaminated industrial wipes, EPA conducted a risk screening analysis to identify potential risks to human health from the management of solvent-contaminated industrial wipes. A summary of the results of the Agency's risk screening analyses is provided below. More detailed information on the results of these risk analyses is presented in section V of this document and in "*Risk from the Disposal of Solvent-Contaminated Shop Towels and Wipes in Municipal Landfills*," October, 1998.

EPA conducted a risk screening analysis to better understand the risks from disposal of solvent-contaminated industrial wipes in a landfill. The purpose of the risk screening analysis was to determine constituent-specific risks from the disposal of solvent-contaminated industrial wipes in a municipal solid waste landfill. The results of the risk assessment can be applied to the following questions: (1) which constituents present the most risk? (2) using reasonable assumptions, do circumstances exist where disposables can be managed in landfills and result in negligible risk? and (3) can the quantity of solvent resulting in negligible risk be quantified?

The results of the risk screening analysis included the identification of F-listed solvents that could be disposed in a municipal solid waste landfill without posing an unacceptable risk. This evaluation was conducted for the 30 constituents that are part of the F001 to F005 hazardous waste listings. The risk analysis results show that 11 of the compounds may present risk using certain disposal assumptions, while 19 of the compounds did not present a risk using the methodology employed.

EPA estimated the daily F-listed sludge residue loadings from industrial laundry wastewater treatment processes using a different approach. EPA's Office of Water conducted sampling at numerous industrial laundries as part of effluent guidelines development for the 1997 proposed rule. Using concentrations of the 30 F-listed solvents in washwater from industrial laundry processes, EPA first estimated the amount of F-listed solvent that could be contained in the sludge using a mass balance model that also accounted for emissions to the air and water (e.g., by a public sewer). Since the washwater concentration data was limited to only 11 F-listed solvents, EPA made assumptions for the other 19 F-listed solvents using the maximum concentration found for one of the solvents, methyl ethyl ketone (MEK). MEK was selected

because it is a frequently used solvent and other solvents would be expected to be present at levels no higher than for MEK. EPA then repeated the same comparative analysis as above to determine which solvent sludge residues could be disposed in a municipal landfill without posing a significant risk to human health and the envirnoment. No solvents posed a problem, except 2-nitropropane, which has not been found in use by any generator.

With respect to ash from combustion units containing solvent residues, EPA used assumptions consistent with those outlined above for the direct landfilling of disposable wipes to first derive total daily loadings to a municipal waste combustor. EPA then assumed a 99.99 percent destruction rate to derive a landfill loading for each of 30 F-listed solvents. As with the above landfill analysis, EPA compared the estimated total daily landfill loadings to the risk loading threshold to determine which F-listed solvents could be managed in a municipal waste combustor, with ash subsequently disposed in a municipal landfill, without posing a significant risk to human health and the environment. No solvents were found to pose a problem.

In addition, EPA examined the ecological risks from exposure to ten F-listed solvent constituents for which ecological benchmark data was available.

Conducting the above risk screening analyses required the use of numerous assumptions and estimations. These included how many industrial wipes are used annually; how much solvent is contained on each wipe; how the solvent-contaminated industrial wipes, ash or sludges behave once in the landfill; and what levels of solvent may pose a risk to human health. In conducting these analyses, EPA sometimes used conservative assumptions to account for a lack of data and possible inaccuracies in the existing data. More details about these assumptions and the reasons for them are discussed in section V.

I.D.3.b. Summary

Results indicate that solvent-contaminated industrial wipes do not pose an air emissions problem when managed in a municipal solid waste landfill (MSWLF) or municipal waste combustor. However, after conducting a risk screening analysis of the potential risks associated with disposing solvent-contaminated industrial wipes in a municipal solid waste landfill, the Agency concludes that 11 F-listed solvents used in conjunction with disposables could pose potential health risks at levels of concern. Surface water runoffs from a MSWLF or from ground water to a surface water body also were found not to pose an adverse risk to human health and the environment.

I.E. *Overview of Proposed Rule*

Based upon the results of the Agency's risk screening analyses and its investigation into potential damages from the management of solvent-contaminated industrial wipes, as well as a review of the issues and questions raised by stakeholders regarding the Agency's current policy governing the regulation of these materials, the Agency has decided to propose (1) a conditional exclusion from the definition of hazardous waste for disposable industrial wipes that are contaminated with hazardous solvents and are going to disposal, and (2) a conditional exclusion from the definition of solid waste for reusable industrial wipes that are contaminated with hazardous solvents and are sent for laundering or dry cleaning. The proposed rule both clarifies

the federal regulations governing solvent-contaminated industrial wipes and establishes a set of performance-based management conditions for the exclusions for both diposable and reusable industrial wipes.

The proposed rule provides a conditional exclusion from the definition of hazardous waste and a conditional exclusion from the definition of solid waste. The proposed conditions for attaining either exclusion include requirements for generator facilities and for handling and processing facilities.

I.E.1. *Generator Conditions: Exclusion from the Definition of Hazardous Waste*

For disposable solvent-contaminated industrial wipes that will be managed at a non-landfill facility to meet the exclusion from the definition of hazardous waste, generators would be required to (1) accumulate and store solvent-contaminated wipes on site in non-leaking covered containers; (2) ensure that the solvent-contaminated wipes do not contain free liquids, except as noted below, when transported off site to a handling facility; and (3) transport the solvent-contaminated industrial wipes off site in containers designed, constructed, and managed to minimize solvent loss to the environment and labeled "Excluded Solvent-Contaminated Wipes."

The proposed rule would require that disposable solvent-contaminated industrial wipes managed at municipal landfills or other non-hazardous waste landfills that meet the standards under 40 CFR Part 257 Subpart B (the disposal standards applicable to the receipt of CESQG wastes at non-municipal, non-hazardous waste disposal units)[1] (1) must be "dry" (i.e., contain less than five grams of solvent each), and (2) must not contain any of the 11 F-listed spent solvents that the Agency has determined may pose adverse risks to human health and the environment when disposed in a landfill, even if the wipe is "dry." Industrial wipes contaminated with the solvents listed in Table 1 would not be allowed in municipal landfills or other non-hazardous waste landfills under the provisions of this proposal.

Table 1
F-listed Solvents Ineligible for Municipal or Other Non-Hazardous Landfill Disposal

2-Nitropropane	Nitrobenzene
Methyl Ethyl Ketone (MEK)	Methylene Chloride
Pyridine	Benzene
Cresols (o,m,p)	Carbon Tetrachloride
Chlorobenzene	Tetrachloroethylene
Trichloroethylene	

In addition, EPA is proposing that transporters be allowed to carry industrial wipes with free liquids to other facilities within the same company under the hazardous waste exclusion when

[1]For the purposes of the preamble and background documents for this proposal, we will use the term *other non-hazardous landfill* to denote Part 257 Subpart B compliant non-hazardous waste landfills. If a non-hazardous landfill that is not a municipal landfill accepts this waste, it must meet the minimum standards of 40 CFR Part 257 Subpart B.

they are transporting them to a solvent recovery facility that will remove enough solvent to meet either the "no free liquid" or the "dry" condition, provided the other conditions of the exclusion are met.

I.E.2. *Generator Conditions: Exclusion from the Definition of Solid Waste*

For reusable solvent-contaminated industrial wipes to meet the exclusion from the definition of solid waste when they are going to be reclaimed and reused, generators would be required to (1) accumulate and store solvent-contaminated industrial wipes on-site in non-leaking covered containers; (2) ensure that the solvent-contaminated industrial wipes do not contain free liquids when laundered on-site or transported off-site to a handling facility, except as noted below; and (3) transport the solvent-contaminated industrial wipes off-site in containers designed, constructed, and managed to minimize losses to the environment (e.g., plastic bags, 55-gallon drums, or other containers). The exclusion from the definition of solid waste would be applicable only to industrial wipes that are being reclaimed for reuse through a cleaning process.

EPA is also proposing that industrial wipes can be transported with free liquids to facilities within the same company under the exclusion when they are transporting them to a solvent recovery facility that will remove enough solvent to meet either the "no free liquid" or the "dry" condition, provided the other conditions are met.

I.E.3. *Handling Facility Conditions: Exclusion from the Definition of Hazardous Waste*

For disposable industrial wipes to continue to meet the exclusion from the definition of hazardous waste, combustors and facilities that handle disposable solvent-contaminated industrial wipes to remove solvent from them prior to disposal would be required to manage the industrial wipes (a) in containers designed, constructed and managed to minimize losses to the environment that meet the transportation requirements in the proposed rule or (b) in non-leaking covered containers that would meet the generator accumulation conditions in the proposed rule. Unless the industrial wipes are being transported under the intra-company provision of the exclusion, if a handler discovers any free liquid accompanying the used solvent-contaminated industrial wipes, it would be required either to remove the free liquid and manage it properly as a hazardous waste, if applicable, or to return the container with the wipes and free liquid to the generator.

I.E.4. *Handling Facility Conditions: Exclusion from the Definition of Solid Waste*

For reusable industrial wipes to continue to meet the exclusion from the definition of solid waste, industrial laundries and dry cleaners, as well as facilities that handle solvent-contaminated industrial wipes to remove solvent from them prior to cleaning, would be required to manage the industrial wipes in containers designed, constructed and managed to minimize losses to the environment (i.e., the proposed transportation condition), or in non-leaking covered containers that would meet the generator accumulation conditions in this proposal. Unless the industrial wipes are being transported under the intra-company provision of the exclusion, if a handler discovers any free liquid accompanying the used solvent-contaminated industrial wipes, it would be required either to remove the free liquid and manage it properly or to return the container with the industrial wipes and free liquid to the generator.

II. Characteristics of Waste and Waste Handlers

II.A. *Description of Industrial Wipes and Their Uses*

Industrial wipes come in a wide variety of sizes and materials to meet a broad range of applications. For the purposes of this proposed rule, EPA is distinguishing between two categories of industrial wipes: reusables, which are laundered and used again; and disposables, which are managed in a landfill or combustor. Although this rulemaking does not distinguish between the types of disposable and reusable wipes, this chapter of the background document describes some of the details of the waste stream.

Wipes are most likely to come in contact with hazardous solvents when wiping up spills of hazardous materials or oil, cleaning machinery or equipment, and wiping off metals or other components in the manufacturing process. The type of wipe suitable for each application depends on a number of factors. The amount of lint a wipe generates can play a large role because some processes, such as those in electronic or printing applications, cannot tolerate any lint, while others, such as cleaning automobile parts, can tolerate large amounts. Absorbency is also an important factor in some tasks, but not in others. Likewise, durability is important in some tasks, such as those with heavy scrubbing, but is often not important in task for which lint or absorbency is more important. Durability does not only refer to the physical strength of the wipe, but also to its ability to withstand strong solvents.

The industrial wipes market consists of an estimated 471,000 facilities in 13 economic subsectors, using approximately 9.6 billion wipes annually. Approximately 3.8 billion wipes contaminated with solvent are used annually by over 200,000 of these facilities. This chapter provides background information and sources on how EPA derived these estimates and provides a breakdown by disposable and reusable industrial wipes categories.

The "Economics Background Document" for this rulemaking, available from the RCRA Docket, also provides information on this topic.

II.A.1 *Disposables*

II.A.1.a. Non-wovens

Non-woven disposable industrial wipes are spun from synthetic fibers and are often combined with wood pulp, although they are not solely paper-based. These wipes are used in all the industries where reusables are used, but are often used for tasks where absorbency and low lint are higher priorities than durability. Nevertheless, there are a wide range of types available, from delicate wipes designed for work with electronics or optics to heavy-duty wipes designed for use with heavy machinery or in metal fabrication. The 1997 Economic Census reports 20 non-woven wipes manufacturers. The industry has recently experienced some consolidation, in which the four leading companies merged into two.

Non-wovens range in price from 4 to 17 cents per wipe (median price of 9 cents).

II.A.1.b. Wovens

Woven cloths or rags have a somewhat smaller share of the disposables market than non-woven wipes. Rags are recycled textiles, made from leftover textile manufacturing scraps or secondhand clothing. Therefore, they come in a wide variety of materials, shapes, colors and sizes. Since the materials are usually inexpensive for producers to obtain, rags are often less expensive than a comparable amount of non-wovens.

The woven rag industry is characterized by 488 establishments (1997 Economic Census) that obtain the materials, sort them, cut them to size, and package and distribute them according to orders. Orders are often assembled on demand according to the specific needs of a customer (e.g., large, white, terry cloth rags only). When not produced to a specific order, a bundle of rags consists of mixed materials, colors, and sizes, and is less expensive.

Rags are usually used in applications where inconsistency is not an issue, such as wiping up a spill. The amount of lint in rags is highly variable, so they are often used in applications where lint is not an issue, either. Rags are often very durable, so they can be used multiple times before ultimate disposal.

II.A.2. *Reusables*

Manufacturers of reusable industrial wipes, often called *shop towels,* usually sell their wipes to uniform and linen rental services *(industrial laundries),* who then rent them to their customers. The rental services typically pick up the reusable wipes once a week from their customers and deliver fresh ones at the same time. Industrial laundries are usually small companies dispersed geographically, each serving an area with a radius of less than 100 miles. However, some industrial laundries operate in multiple states. There are 1,175 industrial laundry establishments that supply reusable industrial wipes (1997 Economic Census).

Although customers can usually specify which kind of reusable wipe they want, they do not get the same wipes they used the week before. Therefore the wipes can be contaminated with small amounts of residual solvents, soil, or metal chips from use by another business. Some businesses, when asked, indicated that they had discontinued or restricted reusable wipe use because metal chips in the wipes were scratching their product. This, in addition to theie high level of lint, restricts reusables' usefulness on delicate applications. Their high durability, however, makes them very useful in heavy duty applications.

Reusable wipe services cost about five cents per wipe per week to rent (national average price). Reusable industrial wipes are typically between 14"x14" and 18"x18" in size, and weigh about one ounce. Wipes range from 65 to 90 percent cotton, with the balance being composed of polyester, rayon, or acrylic. There are many different brands of reusable in use, and at least four companies that make them (1997 Economic Census).

II.B. *Types of Solvents Used in Conjunction With Industrial Wipes and Regulatory Status*

II.B.1. *Study Results*

The hazardous solvents used by industry in conjunction with industrial wipes vary by company; firms tend to have unique usage patterns. Sometimes the amounts of solvent used on each wipe is small but other times it is two or more times the weight of the dry wipe. Also, some firms use small numbers of wipes on a daily basis, while others use hundreds, if not thousands, daily. Finally, the types and concentration of solvent used is often unique to the firm. Most often the solvents used represent a blend of two or more chemical constituents. Some of these spent solvents are hazardous because of their toxicity or ignitability, whereas others have been listed by EPA as a hazardous waste (i.e., F001-F005 listed solvents found in 40 CFR 261.33). Many firms could be directly affected by the proposed rule depending upon the variables described above.

According to data provided to EPA by trade associations, site visits, previous EPA rulemaking efforts, and a review of publicly available data and published reports, the types of solvents applied to industrial wipes (and therefore potentially affected by this proposed rulemaking) varies considerably across numerous industry sectors. As displayed in Table 2, at least 13 economic sub-sectors representing 113 different industries generate solvent-contaminated industrial wipes. Even within the same industry, as witnessed by EPA during site visits, the type and quantity of solvent used in conjunction with industrial wipes varies significantly from one facility to the next.

Table 2
NAICS Codes and Associated Economic Sub-Sectors Using Industrial Wipes

Item	Economic Sub-Sector (Entity Type)	NAICS Code

1	Printing manufacturing (mfg)	323
2	Chemical & allied products mfg	325
3	Plastics & rubber products mfg	326
4	Fabricated metal products mfg	332
5	Industrial machinery & eqpt mfg	333
6	Electronics & computers mfg	3344
7	Transportation eqpt mfg	336
8	Furniture & fixture mfg	337
9	Auto dealers (retail trade)	4411
10	Publishing (printed matter)	5111
11	Business services (photocopy shops)	561439
12	Auto repair & maintenance services	8111
13	Military bases	92812

Unfortunately, definitive data on the types of solvents used in conjunction with industrial wipes is scarce and highly variable. However, the most commonly identified solvents used in conjunction with these wipes, based on available data analyzed for this proposed rulemaking, are presented in Table 3. Given the number of different solvents used in industrial operations, this list is not intended to include all possible solvent uses and is intended for illustrative purposes only. Note that several of the solvents presented in Table 3 are included in the EPA list of hazardous waste solvents F001-F005 in 40 CFR Part 261 subpart C. Others, however, are not and would probably be considered hazardous wastes only if they exhibited one or more of the characteristics of hazardous waste (e.g., ignitability) defined in 40 CFR 261 subpart D, when spent.

Table 3
Solvents Used in Conjunction with Industrial Wipes

Solvent	Source of Data	Potential Waste Code(s)	Principal Use
Toluene	EPA Site Visit, EPA ORD[a], EPA OW[b]	D001, F005[c]	- cleaning paint guns - parts cleaning - general equipment cleaning and preparation - cleaning screening boards
Isopropyl alcohol	EPA Site Visit	D001	- cleaning screening boards - polishing and paint removal - general parts cleaning
Methyl ethyl ketone	EPA Site Visit, EPA ORD	D001, F005	- cleaning rollers - adhesive - cleaning airplane propellors - polishing and paint removal - cleaning screening boards - surface preparation
Methanol	EPA Site Visit	D001, F003	
Methyl isobutyl ketone	EPA Site Visit	D001, F003	- adhesive - cleaning rollers
Ethyl acetate	EPA Site Visit	D001, F003	
Acetaldehyde	EPA Site Visit	D001	
Acetone	EPA Site Visit, EPA ORD	D001, F003	- cleaning paint guns - polishing and paint removal
Diacetone alcohol	EPA Site Visit	D001	- cleaning screening boards
n-by\butyl alcohol	EPA Site Visit	D001, F003	
Propyl acetate	EPA Site Visit	D001	
Ethanol	EPA Site Visit, EPA ORD	D001	- dilute inks - general cleaning
n-propyl alcohol	EPA Site Visit	D001	- dilute inks - general cleaning

Solvent	Source of Data	Potential Waste Code(s)	Principal Use
Petroleum naphtha	EPA ORD	D001	
Xylenes	Printer, EPA ORD	D001, F003	- equipment cleaning and preparation - parts cleaning
Mineral spirits	EPA ORD	D001	- screen cleaning
Acetates	EPA ORD	D001, F003	
1,1,1-trichloroethane	EPA OW	D001, F001/F002	- painting operations
Chlorobenzene	EPA OW	D001, F002	Degreaser
Ethylbenzene	EPA OW	D001, F003	
Methylene chloride	EPA OW	D001, F001/F002	Degreaser
Tetrachloroethylene	EPA OW	D001, F001/F002	Degreaser
Trichloroethylene	EPA OW	D001, F001/F002	Degreaser
Cresol	EPA OW	D001, F002	

ORD = Office of Research and Development
OW = Office of Water

a EPA Office of Research and Development, "Environmental Assessment of Shop Towel usage in the Automotive and Printing Industry," November 1996.

b EPA Office of Water, "Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category," EPA 821-R-97-007, November 1997.

c Waste codes for listed solvents (F001-F005) are provided if the solvent is included in the respective listed waste code definition. The ignitable waste code (D001) is included for solvents that usually have a flash point below 140°F before use. Note that any solvent-contaminated industrial wipe may exhibit this or any other characteristic of hazardous waste after use if the waste meets any of the characteristic waste definitions in 40 CFR 261 subpart C.

II.B.2. *Study Methodology*

Numerous sources of information were reviewed to identify which solvents are more likely to appear in solvent-contaminated industrial wipes. Based on the information collected, no single source provides comprehensive information on the types of solvents used across multiple industries. The sources used as references for this study are described below.

Biennial Report Data

The 1997 Biennial Report System (BRS) was searched for data on large quantity generators (LQGs) of hazardous waste solvents reported as generated in a form similar to solvent-contaminated industrial wipes. This query was conducted specifically for generators of listed hazardous solvent wastes (F001-F005) who used form code B310 (absorbents) on the BRS GM form. This search identified numerous facilities across many industries that potentially generate solvent-contaminated industrial wipes. This search allowed for identification of specific

groupings of solvents through listed solvent waste codes, although identification of which specific solvent within each waste group was generally not possible. Other limitations on this search are described below.

The BRS query is probably inexact about the number of generators and the quantity of solvent-contaminated industrial wipes generated. First, as form code B310 is defined as *inorganic solid spent filters and adsorbents,* it could include other types of absorbent materials besides wipes (e.g., laboratory wastes). Thus, the BRS data probably includes some number of waste streams that are outside the scope of this rulemaking. Also, BRS data for characteristically hazardous solvent-contaminated industrial wipes reported as D001 cannot be differentiated from other, non-solvent D001 wastes; no attempt was made to identify from BRS data solvent usage that resulted in the generation of characteristic-only wastes.

However, BRS data does not include generation information for small quantity generators (SQGs) or conditionally exempt small quantity generators (CESQGs). As both SQGs and CESQGs are known from other data sources to generate solvent-contaminated industrial wipes, BRS data probably understates generation quantities for smaller facilities. Also, as some states may not regulate reusable industrial wipes as hazardous wastes, these wastes may not be reported in BRS; therefore, queries probably do not represent this part of the generating universe.

Trade Associations

Several trade associations provided information to EPA concerning the types of solvents used by facilities in different industries associated with solvent-contaminated industrial wipes. EPA also collected and received information from manufacturers of these solvent manufacturers/distributors and industrial laundry facilities, including the Association of Nonwoven Fabrics Industry, and the Kimberly-Clark Corporation. In 1997, the Screenprinting & Graphic Imaging Association conducted a survey of member firms in the printing industry and found that the printing industry uses the following solvents most often: methyl ethyl ketone (18 percent), acetone (27 percent), xylene (19.5 percent), toluene (20 percent), and mineral spirits (25 percent). Results of a 1997 survey conducted by the Flexographic Technical Association indicate that the following solvents are used most often by members of this industry: ethanol, normal propanol and fast blends, as well as acetates and water-based cleaners.

Office of Water Study of Industrial Laundries

To support their investigation of the national need for pretreatment standards for industrial laundries, EPA's Office of Water conducted an extensive study in the mid-1990s of contaminants present in discharges from industrial facilities that launder industrial textile items, including reusable industrial wipes, specifically printer wipes. Although direct linkage to solvent-contaminated industrial wipes is not certain at all facilities investigated by EPA for this rulemaking, and there is no certainty that other items outside the scope of the proposed rulemaking are not laundered at these facilities, EPA knows from site visits that the effluent from industrial laundries does contain concentrations of solvents expected to be used in conjunction with wipes by the industries identified as generators of solvent-contaminated industrial wipes in section II.A. Extensive data on contaminants (both solvent and non-solvent) is presented in the *Technical Development Document for the Final Action Regarding Pretreatment Standards for*

the Industrial Laundries Point Source Category (EPA-821-R-00-006, March 2000).

Site Visits

In 1996 and 1997, EPA visited 17 facilities that use industrial wipes in different industry sectors: printing; auto body repair, aerospace manufacturing and maintenance; circuit board manufacturing; ship maintenance; and coating and adhesive testing and production. EPA collected sampling data on solvent-contaminated industrial wipes from several of these facilities on types and amounts of solvent applied to the wipe. The solvents reported to be used at the sites included the following chemicals: toluene, isopropyl alcohol, methyl ethyl ketone, methanol, methyl isobutyl ketone, ethyl acetate, acetaldehyde, acetone, diacetone alcohol, n-butyl alcohol, propyl acetate, ethanol, and n-propyl alcohol. The solvents were applied to the wipes primarily through spraying, dipping, or pumping.

Publicly Available Information/Literature Search

EPA conducted a literature search for chemicals in solvent blends used by industries on industrial wipes. EPA also reviewed previous studies on this topic, including a report from the EPA National Risk Management Research Laboratory: *Environmental Assessment of Shop Towel Usage in the Automotive and Printing Industries.*

Information on solvent use at facilities was compiled through site visits and Internet searches of Materials Safety Data Sheets (MSDSs) for solvents used in the target industries (e.g., printers, automobile manufacturers, auto body repair and maintenance shops, furniture manufacturers, aircraft manufacturers) The facilities identified through the Internet search specified the task (e.g., blanket wash, stripper) for which the solvent was intended. The task determined whether it was likely that the solvents were being used with industrial wipes.

A third literature search included the Stanford Research Institute's listings of cleaning/degreasing solvents in the Chemical Economics Handbook (1997 edition). Although not specific to industrial wipes applications, this source revealed that there are at least 26 different chemicals used as cleaning/degreasing solvents, with the top five by annual volume representing 85 percent of all solvents used for cleaning/degreasing (naphtha, acetone, methanol, toluene, trichloroethylene). The "Economics Background Document" presents the results of this data search.

EPA did not identify any single data source that provides a comprehensive list of solvents used in conjunction with solvent-contaminated industrial wipes. Based on analysis of data collected from the cited sources, the following generalizations are possible:

- Solvents in the workplace are used for cleaning equipment, cleaning up small spills, and other industrial applications. As there is generally a direct correlation between the type of equipment that must be cleaned and the type of solvents required to adequately clean the equipment, some equipment may require solvents that contain constituents with relatively strong cleaning capabilities, while other types of equipment may require less powerful chemical constituents in the solvent (cleaning agent).

- Worker preferences can affect the type of solvent used even within the same facility due to personal experiences with what solvent products work better than others.

- Solvent manufacturers continue to create new products that offer more effective cleansing agents but have reduced health and environmental damage risks (i.e., lower volatile organic compound emissions and water-based solvents). Additionally, numerous parties during site visits and in public comments to proposed rulemakings cite a long-term trend for reduction in the use of halogenated solvents, particularly in military applications, by solvent substitution with petroleum naphtha or isopropyl alcohol-based solvents. However, EPA does not have conclusive, quantified evidence that such reductions are occurring.

II.C. *Affected Universe of Generators of Spent Industrial Wipes and Off-site Management Facilities*

Because users and user characteristics of solvent-contaminated industrial wipes are so diverse, the methodology used to estimate the universe of facilities using these materials is eclectic in nature. The first step involved identifying potential industry sectors. This was accomplished through a literature search, and discussions with key stakeholders and industry contacts who could further describe industry demographics with respect to solvent-contaminated industrial wipes. An important source in identifying industrial sectors was EPA's Office of Enforcement and Compliance Assistance (OECA) Industry Profile Series that identified potential users of solvent-contaminated industrial wipes by four-digit standard industry code (SIC). This source also identified industry, regional EPA, and state contacts who further assist in describing the universe of users.

Table 4 provides an estimate of the number of facilities potentially affected by the proposed rule. This estimate is displayed by industrial sector and by RCRA regulatory status (i.e., CESQG, SQG, and LQG). As stated, EPA has identified 13 economic sub-sectors that use solvents in conjunction with industrial wipes for wiping or cleaning operations. In some cases, we believe large numbers of establishments are involved, such as printing and auto body repair. We believe other sectors also might use hazardous solvents in conjunction with industrial wipes but, for example, we were unable to collect sufficient information about the transportation equipment industry or general building contractor sectors to include them in our analysis.

In total, we estimate that as of 2001, approximately 159,000 firms use solvents in conjunction with industrial wipes. Of this total, approximately 32 percent are CESQGs who will not be affected by this rule. The remaining 68 percent (109,000 establishments) could potentially be affected by this rule. These establishments are mostly SQGs (66 percent), although there are some LQGs (2 percent).

Other variables are the types of industrial wipes that might be prevalent in an industrial sector, as well as whether small or large numbers of these wipes might be used on a daily basis. EPA relied on industry contacts familiar with this issue, site visits, information provided by industry, and discussions with inspectors to provide this information.

Table 5 summarizes the results of this effort. Tremendous variability exists both in terms

of usage patterns and quantities of industrial wipes used daily. For instance, the Printing Sector primarily uses reusable industrial wipes; however, within this diverse sector, up to 40 percent of screenprinters, approximately 16,000 firms, use disposables. Similarly, the frequency of usage varies tremendously depending on the size of the firm. Smaller firms may use 50 industrial wipes a day, while large printers or newspapers can use more than 1,000 industrial wipes a day.

Table 4
Entities Potentially Affected by the Proposed Rule

Item	Economic Sub-Sector (Entity Type)	NAICS Code	SIC Code	Number of Affected Establishments[a]
1	Printing manufacturing (mfg)	323	275 to 279	18,700 to 42,000
2	Chemical & allied products mfg	325	28	1,100 to 2,900
3	Plastics & rubber products mfg	326	30	1,400 to 3,700
4	Fabricated metal products mfg	332	34	4,900 to 13,000
5	Industrial machinery & eqpt mfg	333	352 to 356	2,400 to 6,300
6	Electronics & computers mfg	3344	367	550 to 1,500
7	Transportation eqpt mfg	336	37	1,100 to 3,000
8	Furniture & fixture mfg	337	25	1,600 to 4,300
9	Auto dealers (retail trade)	4411	5511 & 5521	4,000 to 10,700
10	Publishing (printed matter)	5111	271 to 274	10,600 to 23,600
11	Business services	561439	7334	2,900 to 6,400
12	Auto repair & maintenance	8111	753	13,500 to 35,900
13	Military bases	92812	9721	50 to 130
14	Solid waste services	562	4953	4,800 to 9,650
15	Industrial launderers	812332	7218	590 to 1,175
			Total =	68,000 to 164,000

[a] Establishment counts above do not necessarily represent all establishments in each industry; counts represent EPA's estimate of establishments which use solvent industrial wipes and to which the conditional exclusions may apply.

Table 5
Daily Usage Statistics/Trends

Industrial sector	Average Daily/Weekly Usage Trends
Printing	Reusables: 200 to 2,000 per week, per facility; Disposables: 300-800 per week
Auto Body Repair	Between 50 and 100 per day, depending on size of facility
Furniture Manufacturers	Large firms: up to 25 55-gallon drums; Smaller firms: 7 55-gallon drums
Aerospace Manufacturers	Tremendous variability. Smaller users: 25 industrial wipes or less per day; Larger users: up to 1,000 or more per day
Automobile Manufacturers	Several hundred wipes per day (if not more) appear to be used at large assembly plants
Electronics & Computers	Large semiconductor facility can use several thousand wipes per day; printed wire board facilities use approximately 100 industrial wipes per day (mostly disposable)
Military Bases/Facilities	Varies by operation. Depot maintenance facilities probably use hundreds per day; other operations, such as on ships, fewer
Fabricated Metals	No statistics available, but we believe relatively small numbers used daily per facility primarily for wiping operations
Industrial Machinery	No statistics available, but we believe relatively small numbers used daily per facility primarily for wiping operations
Plastics/Rubber	No statistics available, but we believe relatively small numbers used daily per facility primarily for wiping operations
Chemical & Allied Products and Inorganic Chemicals	No statistics available, but we believe relatively small numbers used daily per facility primarily for wiping operations

Other sectors using large numbers of industrial wipes per day include automobile manufacturers, large furniture manufacturers, and parts of the defense industry. Sectors using small numbers of industrial wipes per day include auto body repair shops, fabricated metals, and organic and inorganic chemical manufacturers. On the whole, there appear to be more industries that use smaller numbers of industrial wipes on a daily basis than that use large numbers of wipes.

EPA obtained industry information to determine the fraction of wipe uses associated with solvents, as opposed to other materials. Kimberly-Clark Corporation, a major manufacturer of non-woven wipes provided EPA with estimates of the percentage of uses associated with solvents in the printing industry and in all other sectors. These percentages were applied to the data to derive an estimate of the number of disposable industrial wipes used each year in conjunction with solvents.

According to the industry source, 10 percent of the solvents used in the industry are non-hazardous when spent. Additionally, 80 percent of the solvents used in the printing industry are characteristic hazardous wastes when spent and 10 percent are listed hazardous wastes when spent. EPA then assumed that 50 percent of the wipes contaminated with solvents that are characteristic hazardous wastes when spent continue to exhibit a characteristic of hazardous waste after contamination.

Disposable industrial wipes are used by themselves for wiping, spill cleanup, degreasing and other applications, but EPA is particularly concerned about applications in which they are used in conjunction with solvents. In certain industries like printing, a majority of wipe uses involve solvents, whereas in some other industries, the use of solvents may be less common.

The Agency estimates that 316 million disposable industrial wipes are used in conjunction with RCRA-regulated solvents each year, making up 28 percent of the 1.13 billion disposable wipes used annually. EPA notes that many individuals representing trade associations and/or industrial users of disposable industrial wipes and solvents told the Agency that generators, especially larger ones, avoid using disposable industrial wipes with hazardous waste. Knowing that hazardous waste disposal adds significantly to the effective cost of using disposables, many firms opt for reusable industrial wipes instead for applications involving solvents that ultimately will be hazardous waste. Therefore, the overall use of disposables with hazardous waste may be less than estimated.

II.D. *Description of Generator Waste Management Practices for Spent Wipes*

EPA found much variability in the uses of solvent-contaminated industrial wipes and management practices regarding them across and within industries. In addition, there are significant differences in management practices depending on whether the cloths are reusable or disposable.

Waste management of solvents and solvent contaminated industrial wipes has several steps. The first is the application of the solvent and the use of the wipe. Solvents are applied in varying amounts depending on their use, the type of solvents, and the environmental awareness of the business. Some businesses in the printing industry, for example, are trying to cut back on the amount of hazardous solvents used and the amount of solvent used on each wipe. There are various incentives for reducing solvent use, particularly in the case of solvents used with reusable industrial wipes. Many laundries will not accept shipments of wipes that contain free liquids. Other users, such as metal finishers, do not apply solvent to the wipe, but submerge the component they are working on in a solvent bath, and then use the wipe to dry the component off. The wipe may be used in this manner repeatedly until it is saturated. Some users soak their industrial wipes in a solvent before use, while others rarely use any solvents at all with their wipes. Unfortunately, from this wide array of practices, it is difficult to draw any conclusions about the prevalence of any one practice.

After an industrial wipe's use is served, the next step is the temporary storage of the spent wipe by the user. Where wipe usage is high, there is often a container at each work station for that worker's used wipes. One commonly used container is a closed metal container with a foot pedal to open the top of the container. When the container is full, or at the end of the day, these

containers are usually emptied into a central container at the facility. In smaller facilities with lower wipe usage, there may only be one container in the facility for accumulating the wipes prior to off-site management. Prior to discarding spent wipes in the container, generators may sometimes store their wipes on shelves (or other storage mechanism) for pickup at the end of the day.

EPA has found that solvent removal technologies are primarily practiced by generators of reusable industrial wipes. Many states exempt reusable industrial wipes from regulation as a hazardous waste if the wipes do not contain free liquids when shipped from the generator site. Solvent removal technologies include the use of screen bottom drums, hand wringing, mechanical wringing, and centrifuging.

The central container at a generator's establishment can vary in size from a small bucket to a large bin on wheels. It is usually covered and air tight, although one manufacturing plant that was visited by EPA used a cloth laundry bag to accumulate reusable industrial wipes. An official of one large print shop who was interviewed for this study had a different approach to wipe management. At this print shop, reusable industrial wipes are collected from cans at each work station and put in a large laundry bin on wheels, which is lined with a plastic bag. The bins of wipes are then wheeled to an on-site centrifuge. Centrifuged wipes then are put in a lined laundry bin that is covered with a stainless steel top that was fashioned by the shop owners themselves. This facility is not typical, however, as most generators do not currently appear to practice solvent extraction.

When solvent-contaminated industrial wipes are accumulated and stored in containers, the solvents in the wipes tend to percolate from the top to the bottom of the container over time. This is particularly noticeable when large amounts of solvent are applied to the wipes. Free liquids occur at the bottom of the containers, and generators can easily violate a "no free liquids" transportation condition if the containers are not examined and the free liquids are not removed from the container prior to shipping the cloths off site. For this reason, many generators use screen bottom drums to accumulate used or spent industrial wipes and to segregate and collect the free liquids that percolate to the bottom of the container. Other generators may extract solvents from spent or used wipes by hand wringing, mechanical wringing, or centrifuging the wipes prior to storing them or shipping them off site. In the case of disposable industrial wipes, some generators may not employ any solvent-extraction technologies prior to shipping the materials off site due to the fact that most states regulate disposal wipes contaminated with hazardous wastes solvents as hazardous wastes, regardless of the amount of solvent present in the wipes.

The next step in waste management at generator facilities is to transfer reusable industrial wipes to the laundry service and/or transfer disposable industrial wipes to off-site hazardous waste management facilities. In the case of reusable industrial wipes, some generators transfer the whole storage container to the launderer, while other generators transfer the wipes to a new container before they are picked up by the laundry. At some facilities, the container of wipes is emptied out on to a large launderable cloth on the floor, such as a fender cover at an auto body shop. The wipes are then counted by the rental service, and the wipe with everything on it is then picked up and put in the laundry truck. This way the laundry service not only shows the customer that they are being honest in their counting, but the service employee can also see if there are any

free liquids in the laundry before accidentally transporting hazardous waste without a permit.

During site visits to generators of disposable industrial wipes, EPA found that generators send their disposable industrial wipes off-site for management at hazardous waste landfills, industrial landfills, municipal landfills, fuel blenders, and hazardous and municipal waste incinerators.

The overall management practices of wipes vary by industry, state, rental service, and facility. Unfortunately, with such a diverse customer base, it is difficult to quantify the prevalence of each practice. Some of the variation in practices is due to the lack of regulations on wipes. With more defined federal regulations, practices may become more standard.

III. Current Regulatory Environment

III.A. *Federal Regulations*

The generation and management of solvent-contaminated industrial wipes are currently regulated under several statutes and regulatory programs at the federal level, as discussed in detail below.

III.A.1. *Resource Conservation and Recovery Act (RCRA)*

III.A.1.a. Hazardous Waste Regulations

Although there are currently no federal regulations under RCRA that specifically establish national guidelines for the management of solvent-contaminated industrial wipes, numerous regulations established under the authority of RCRA do currently apply to generators and handlers of these materials if they are hazardous wastes.

The most stringent interpretation of the federal RCRA program would subject all solvent-contaminated industrial wipes to the hazardous waste mixture rule. Under RCRA, a solid waste is a hazardous waste if it (1) is listed as a hazardous waste under 40 CFR Part 261, Subpart D; (2) exhibits one or more of the characteristics of hazardous waste identified in 40 CFR Part 261, Subpart C; (3) is a mixture of a solid waste and a listed hazardous waste; or (4) is a mixture of a solid waste and a characteristic hazardous waste and the resultant mixture exhibits one or more of the characteristics of hazardous waste.

Under the federal RCRA program, industrial wipes contaminated with listed hazardous waste solvents (i.e., hazardous waste codes F001-F005) would be considered listed hazardous wastes, and they would have to be managed in accordance with all applicable hazardous waste management requirements (e.g., storage standards, recordkeeping, hazardous waste manifest). Those wipes contaminated with spent solvents that are hazardous wastes because they exhibit one or more of the characteristics of hazardous waste would also be hazardous wastes. In addition, solvent-contaminated industrial wipes that exhibit any characteristic of hazardous waste would have to be managed in accordance with all applicable RCRA hazardous waste management standards.

Currently, EPA is not applying the federal hazardous waste management program to the management of solvent-contaminated industrial wipes. The current federal policy with respect to the regulatory status of solvent-contaminated industrial wipes has been to defer hazardous waste determinations to the EPA regions and states. This policy is due primarily to the site-specific nature of the use and characterization of solvent-contaminated industrial wipes and was first articulated in a January 23, 1991 letter from Sylvia K. Lowrance, Director, Office of Solid Waste, to Lance R. Miller, Director of New Jersey's Hazardous Waste Management Division, regarding the petitions submitted by the Kimberly-Clark Corporation and Scott Paper Company. She stated:

> We believe that the best course of action is to make a more comprehensive interpretation in this rulemaking context [solvent-contaminated wipes]. However, given our current resource levels and

> competing high-priority projects, we cannot select a particular target date for the final evaluation of this petition. In the meantime, Regions and states continue to use the current case-by-case approach on this subject.

The policy was reaffirmed in a February 14, 1994 memorandum to the EPA Regional Waste Management Directors from Michael Shapiro, Director, Office of Solid Waste, stating:

> Because there are many applications of wipes, we cannot at this time make any generic statements that all wipes are hazardous waste, or that all are not. A material that is a solid waste is by definition a hazardous waste if it either 1) meets one of the listings in 40 CFR Part 261, Subpart D, or 2) exhibits one or more of the characteristics described in 40 CFR Part 261, Subpart C. Because there are no explicit listings for "used wipes" in Part 261, Subpart D, a wipe can only be defined as listed hazardous waste <u>if the wipe either contains listed waste, or is otherwise mixed with hazardous waste.</u> Whether or not a used wipe contains listed hazardous waste, is mixed with hazardous waste, only exhibits a characteristic of hazardous waste, or is not a waste at all, is dependent on site-specific factors; this is not a new policy. As a result, any determinations or interpretations regarding this diverse and variable waste stream should be made by the regulatory agency (i.e., EPA Region or State) implementing the RCRA program for a particular State. This has been our longstanding policy.

The majority of states and EPA regional offices have created policies dictating that disposable wipes contaminated with a listed or characteristically hazardous spent solvent should be managed as a hazardous waste, while reusable wipes that are managed at industrial laundries or industrial dry cleaners need not be managed as a hazardous waste as long as specific conditions are met. These conditions primarily require that generators ensure that shipments of wipes sent to industrial laundries do not contain free liquids and that industrial laundries be in compliance with applicable Clean Water Act (CWA) regulations. A few states require generators to extract solvent from reusable wipes prior to sending them off site to ensure that free liquids are not transported off site. Industrial laundries also often urge their customers to remove solvents from the wipes prior to being transported off site to ensure compliance with DOT hazardous materials transportation requirements and pretreatment requirements from the local Publicly Owned Treatment Works (POTW).

III.A.1.b. <u>Land Disposal Restrictions</u>

Under the land disposal restrictions (LDRs), listed or characteristic hazardous wastes must meet stringent treatment standards prior to land disposal. These treatment standards are either a numerical concentration limit for hazardous constituents in the waste or the application of a particular treatment technology to the waste (40 CFR Part 268). In addition, "treatment, storage, or disposal of hazardous waste by any person who has not applied for or received a RCRA [Subtitle C] permit is prohibited" (40 CFR §270.1(b)). Furthermore, owners and operators of hazardous waste management facilities must comply with both the general facility and unit-specific operating requirements and performance standards of Part 264 (for permitted facilities) or Part 265 (for interim status facilities), as appropriate.

A wipe contaminated with a listed hazardous waste solvent is a hazardous waste subject to the LDRs by virtue of EPA's hazardous waste mixture rule. Specifically, a mixture of a solid waste and one or more listed hazardous wastes is a hazardous waste unless specifically excluded from regulation (40 CFR §261.3(a)(2)(iv)). A mixture of a solid waste and a hazardous waste that is listed solely because it exhibits a hazardous waste characteristic (as with F003) is also a hazardous waste if the mixture exhibits one or more of the characteristics of hazardous waste (§261.3(a)(2)(iii)). Therefore, under the current regulations a wipe that is contaminated with a listed hazardous waste solvent and that is discarded or intended to be discarded (i.e., is a solid waste) must be managed as a hazardous waste. In addition, as with any solid waste, a discarded wipe that exhibits one or more of the characteristics of hazardous waste (ignitability, corrosivity, reactivity, or toxicity) is a hazardous waste and subject to subtitle C regulation.

For solvent-contaminated wipes that are not intended to be discarded (i.e. not a solid waste, such as reusable wipes sent to an industrial laundry), it could be argued that the hazardous waste mixture rule technically does not apply because that rule applies only to mixtures of solid wastes and hazardous wastes. Nonetheless, solvent-contaminated reusable wipes could be subject to subtitle C regulation pursuant to EPA's "contained-in" policy, which has been upheld as a reasonable interpretation of the mixture rules (Chem Waste v. EPA, 869 F.2d at 1539-40).

Under the contained-in policy, EPA requires non-waste materials (e.g., soil, groundwater, and debris) to be managed as a hazardous waste if they contain hazardous waste or exhibit a characteristic of hazardous waste (see, e.g., 63 *FR* 28621, May 26, 1998, LDR Phase IV final rule and 57 *FR* 37194, Aug. 18, 1992, LDR final rule for hazardous debris). However, under the current policy of deferring to the states for interpretation of a wipes regulatory status, most reusable wipes are conditionally excluded from the definition of solid waste or the definition of hazardous waste.

A wipe contaminated with a listed hazardous waste solvent must meet all the LDR treatment standards applicable to that solvent prior to being land disposed. For example, an F001-contaminated wipe must meet the same treatment standards that would apply to a "pure" (unmixed) F001 waste. The existing LDR treatment standards for the non-wastewater forms of F001-F005 wastes are set forth in the table at 40 CFR §268.40, and consist of numerical (concentration-based) standards for 27 different hazardous constituents.

The LDRs generally attach to hazardous wastes when the wastes are first generated (i.e., at the point of generation). Once the restrictions attach, the standards must be met before the wastes can be placed into any land disposal unit (other than a unit which has been granted a no migration variance).[2]

In addition to chemicals included in the F001-F005 hazardous waste listings, other chemicals can be used as solvents in conjunction with wipes, such as acetonitrile, isophorone and phenol, and can cause the wipes to exhibit one or more characteristics of hazardous waste. Such contaminated wipes must be managed as characteristic hazardous wastes and must meet

[2] For purposes of the LDRs, *land disposal* includes any placement of hazardous waste into a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, or underground mine or cave (RCRA §3004(k)).

applicable LDR treatment standards prior to any land disposal.

Importantly, because the LDRs attach at the point of generation, treatment standards must be met fully even if the wipe no longer exhibits any hazardous waste characteristics at the point of land disposal or at the point the wipes are sent for off-site management (61 *FR* 15566-15568, April 8, 1996; LDR Phase III final rule); Chemical Waste Management, Inc. v. EPA, 976 F.2d 2, 12-14 (D.C. Cir. 1992). Assume, for instance, that a spent wipe is not mixed with a listed solvent but exhibits the ignitability characteristic. Assume further that the characteristic is removed from the wipe through wringing or centrifuging after the wipe has become spent but prior to sending the wipe off site for treatment or disposal. In this case, the LDRs must still be met prior to any land disposal of the wipe, even though the wringing or centrifuging has removed the characteristic.[3]

In the case of solvent-contaminated wipes that exhibit a characteristic of hazardous waste and are sent to an industrial laundry, the wipes clearly are not wastewaters that could take advantage of the LDR exemption for treatment in CWA systems. The LDR exemption states that characteristic wastes are not prohibited from land disposal "if they are managed in either a treatment system whose ultimate discharge is regulated under the CWA (including both direct and indirect discharges), a CWA-equivalent treatment system, or a Class I nonhazardous injection well regulated under the SDWA [Safe Drinking Water Act], provided that the wastes no longer are hazardous (i.e., no longer exhibit a characteristic) at the point land disposal occurs" (61 *FR* 15660, April 8, 1996, amendment of LDR Phase III final rule in response to the Land Disposal Program Flexibility Act of 1996). The wastewater discharge from the laundry itself, however, could be eligible for the LDR exemption.

LDRs for Sludges

Under RCRA, any solid waste generated from the treatment, storage, or disposal of a hazardous waste, including any sludge, spill, residue, ash, emission control dust, or leachate, is a hazardous waste (see 40 CFR §261.3(c)(2)(i)). Therefore, the strict interpretation of the federal regulatory program governing the management of wipes contaminated with listed solvents results in the hazardous waste listing (e.g., F001-F005) carrying through to the sludges generated from the management of such wipes at industrial laundries. These sludges therefore are subject to the LDR requirements, and the LDR treatment standards must be met before the sludges can be placed into any land disposal unit. Of course, in the case of those solvents listed solely because they exhibit a characteristic of hazardous waste (e.g., F003) if the resultant solvent-contaminated wipe does not exhibit a characteristic, the "mixture" no longer retains that listing and the listing does not carry through to sludges generated from treatment of the wipe.

[3] Of course, in the case of a wipe contaminated with a listed solvent, the wipe would remain a listed hazardous waste subject to the LDRs unless and until the wipe is excluded from subtitle C regulation by EPA or an authorized state. 40 CFR §261.3(a)(2)(iv). The one exception to this rule is where the solvent is contaminated solely with an F003 solvent, which is listed because the solvent exhibits the ignitability characteristic, and the wipe no longer exhibits any hazardous waste characteristics. §261.3(a)(2)(iii).

III.A.2 *Clean Water Act*

The Clean Water Act was enacted to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Through this authority, EPA implements the National Pollutant Discharge Elimination System (NPDES) permitting program to control discharges of industrial wastewaters directly to waters of the U.S. Indirect discharges to POTWs are controlled through the National Pretreatment Program.

Pursuant to a 1976 settlement agreement and the 1977 Clean Water Act Amendments, EPA was required to develop a program and adhere to a schedule in promulgating effluent limitation guidelines (ELGs) and pretreatment standards for 65 "toxic" pollutants and classes of pollutants, generated across 21 major industries. The Auto and Other Laundries industrial category, of which industrial laundries is a subcategory, was one of the categories required to be studied under the 1976 Settlement Agreement for the possible development of ELGs and standards. Several studies were undertaken from 1977 to 1980 to collect more information about the industrial laundries industry, including two surveys (1977 and 1979) and wastewater sampling and analysis programs conducted in 1978 (screening and verification study).

Following these original studies, additional data was collected by EPA's Industrial Technology Division in conjunction with the Agency's Office of Solid Waste from 1985 to 1987. In 1986, EPA published its Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to POTWs. Based on information gathered to that point, the Agency compiled a profile of the industrial laundry industry that was published as a Preliminary Data Summary in 1989.

According to Section 304(m) of the CWA, added by the Water Quality Act of 1987, EPA is required to establish schedules for promulgating new or revised ELGs and standards. On January 2, 1990, EPA published an Effluent Guideline Plan (January 2, 1990; 55 *FR* 80), in which schedules were established for developing new and revised ELGs and standards for several industrial categories. The Effluent Guideline Plan also listed several industrial categories that were to be studied to determine whether rulemakings to develop ELGs and standards should be initiated. One of those categories was the Industrial Laundries Point Source Category, based on the results of the DSS.

Natural Resources Defense Council, Inc. (NRDC) and Public Citizen, Inc. challenged the Effluent Guidelines Plan in a suit filed in U.S. District Court for the District of Columbia (NRDC et al. v. Reilly, Civ. No. 89-2980). The plaintiffs charged that EPA's plan did not meet the requirements of section 304(m). A consent decree in this litigation was entered by the Court on January 31, 1992 (57 *FR* 19748), that established schedules for, among other things, EPA's proposal and promulgation of ELGs and standards for a number of categories, including the Industrial Laundries Point Source Category.

Under the requirements of the consent decree, EPA proposed ELGs and standards for the Industrial Laundries Point Source Category (December 17, 1997; 62 *FR* 66182). The proposed rule limited the discharge of pollutants into POTWs from existing and new industrial laundries by establishing Pretreatment Standards for Existing and New Sources. EPA did not establish ELGs or standards applicable to industrial laundries discharging directly to waters of the U.S. because

EPA did not identify any direct dischargers and did not identify any available information with which to accurately determine technology-based limitations for direct dischargers. The proposed rule applied to industrial laundries, defined as "any facility that launders industrial textile items from off site as a business activity. Industrial textile items include, but are not limited to, industrial shop towels, garments and uniforms, printer towels, mops, and mats." EPA did not propose regulations for discharges from on-site laundering at industrial facilities, laundering of industrial textile items originating from the same business entity, and facilities that exclusively launder linen items, denim prewash items, new items, any other laundering of hotel, hospital, or restaurant items or any combination of these items. The proposed rule did apply to hotel, hospital, or restaurant laundering of industrial textile items.

On August 18, 1999, EPA published a *Federal Register* Notice withdrawing its proposed rule to establish ELGs and standards for the industrial laundry sector. EPA's primary basis for the withdrawal is that indirect discharges from industrial laundries contain very small amounts of toxic pollutants that are not removed by POTWs. Comments on the proposed rule and subsequent data collection resulted in the following conclusions: (1) laundry discharges are not as toxic as estimated at proposal; (2) POTWs provide better treatment of the toxic pollutants remaining in laundry discharges than estimated at proposal; and (3) individual problems are not prevalent with past problems having been resolved by local pretreatment authorities.

EPA concluded that, to the extent isolated problem discharges occur, existing pretreatment authority allows local POTWs to respond to problems effectively. Local POTWs have the authority to set local limits for individual indirect dischargers to prevent (1) pass-through of pollutants into waters of the U.S., and (2) interference both with POTW operations and sludge disposal options. EPA's pass-through analysis for the rulemaking determined that there is not significant pass-through of pollutants from industrial laundries to waters of the U.S. EPA also concluded that a better way to control effluent discharges of certain organic pollutants, including solvents, is to remove them before they are washed.

III.A.3 *Clean Air Act*

The Clean Air Act (CAA) establishes a national framework for the attainment and maintenance of air quality standards. The national ambient air quality standards (NAAQS) establish national standards for six "criteria" pollutants: carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, lead and ozone. Air pollutants are released from both small stationary sources, such as dry cleaners and auto paint shops, and major sources, such as chemical factories and incinerators. Although the CAA regulates major sources more strictly, EPA is required to regulate small sources of hazardous air pollutants as well. Under the 1990 CAA Amendments, EPA is required to study ways to reduce pollutant emissions from small neighborhood sources.

To reduce air pollution, EPA first identifies the toxic pollutants whose release should be reduced. The 1970 CAA gave EPA authority to list air toxics and then create regulations for those listed pollutants. By 1990, EPA had listed and regulated seven air pollutants. The 1990 CAA Amendments greatly expanded the list and includes 189 hazardous air pollutants (HAPs), which were selected by Congress on the basis of potential health and/or environmental hazard. The 1990 Amendments also allow EPA to add new chemicals to the list as necessary. To regulate HAPs, EPA is required to identify categories of sources that release the 189 chemicals. The air

toxics producers are then identified as major or area sources and promulgate regulations specific to those categories.

Once HAP regulations are established, sources are to use the Maximum Achievable Control Technology (MACT) to reduce pollutant releases to a level considered technically achievable. In some cases, EPA specifies the method required to reduce air pollutants; however, in most cases, companies have the flexibility to choose how they meet the requirements.

Many solvents commonly used in conjunction with wipes are included on the list of HAPs in Section 112 of the CAA. These solvents include: benzene, carbon disulfide, carbon tetrachloride, cresol, ethyl benzene, methanol, methyl isobutyl ketone, methylene chloride, nitrobenzene, 2-nitropropane, tetrachloroethylene, toluene, 1,1,2-trichloroethane, trichloroethylene, and xylene. These solvents may also meet the definition of a Volatile Organic Compound (VOC), a precursor of ozone, which is also regulated under the CAA. Overall, facilities which either generate or handle solvent-contaminated wipes would be subject to regulation under the CAA depending upon the types of solvents used and the amount of emissions released to the air.

The Uniform and Textile Service Association, a trade association representing textile supply and service companies, estimated in their guidance *Reusable Wipes: A Synopsis* that most industrial laundries would not be regulated as a major source. Some industrial laundries, however, may be subject to the CAA regulations for industrial dry cleaners for reasons unrelated to industrial wipes.

III.A.4 *Occupational Safety and Health Administration (OSHA) Standards*

The Occupational Safety and Health Administration (OSHA), an agency of the U.S. Department of Labor, is responsible for creating standards to protect the health and safety of individuals in the workplace. In 1970, Congress passed the Occupational Safety and Health Act in an effort to decrease personal illnesses and injuries resulting from work situations, which place a substantial burden on commerce due to loss of production, loss of wages, medical expenses, and disability compensation payments. The intent of the act was to ensure safe and healthy work environments by authorizing the Secretary of Labor to set mandatory occupational safety and health standards applicable to businesses affecting interstate commerce (29 CFR Parts 1900-1999).

The OSHA standards are generally applicable to all workers in all workplaces, although possible exceptions include miners, transportation workers, public employees, and the self-employed. The Occupational Health and Safety Standards in part 1910 provide both general and specific requirements with which facilities must comply when applicable. Specifically, subpart H of part 1910 contains standards for the management of hazardous materials, including

requirements for the management of flammable[4] and combustible[5] liquids (§1910.106). Many facilities which either generate solvent-contaminated industrial wipes or launder such materials may be subject to these standards.[6] The requirements of §1910.106 outline management and storage practices for facilities that handle flammable or combustible liquids. Several solvents that are listed or characteristic hazardous wastes when spent and that are used in conjunction with wipes meet the definition of a flammable liquid (e.g., acetone, ethyl acetate, ethyl benzene, methyl ethyl ketone, petroleum naphtha).

According to OSHA standards, flammable liquids must be stored in approved containers that meet the requirements of §1910.106(d). Metal containers and portable tanks meeting Department of Transportation standards (see 49 CFR Parts 173 and 178) are acceptable. Section 1910.106 also specifies standards for the areas where containers holding flammable liquids are stored, including requirements for storage cabinets, rooms, buildings, storage outside of buildings, and industrial plants. The requirements for industrial plants may be most applicable to generators or launderers of solvent-contaminated wipes because the regulations apply to the portions of an industrial plant where the "use and handling of flammable and combustible liquids is incidental to the principal business" (e.g., solvents used for cleaning presses at printing facilities). At industrial plants, flammable liquids must be stored in tanks or closed containers.

For purposes of the OSHA regulations, a *closed container* is defined as a container that is sealed with a lid or other device to prevent the release of liquids or vapors at ordinary temperatures (§1910.106(a)(9)). Facilities managing solvent-contaminated wipes may be subject to other OSHA requirements including standards for personal protective equipment (§1910.132-136) and hazard communications (§1910.1200). In addition, facilities may need to comply with the standards for air contaminants under §1910.1000, which set limits on employee exposure to toxic and hazardous substances in the air. Many of the solvents used in conjunction with wipes are included in OSHA's listing of air contaminants for which regulatory exposure limits have been set (e.g., acetaldehyde, acetone, MEK, ethyl acetate).

III.A.5. *Department of Transportation (DOT) Requirements*

The federal Hazardous Materials Transportation Act regulates transportation of hazardous materials. The purpose of the law is to provide adequate protection against the risks to life and property inherent in transporting hazardous materials in commerce. According to the act, a material or a group or class of materials is designated as hazardous if it is determined that transporting the materials in commerce in a particular amount and form may pose an unreasonable

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[4] Flammable liquids are defined as any liquid having a flash point below 100° F (37.8° C) except any mixture having components with flash points at 100° F or higher, the total of which make up 99% or more of the total volume of the mixture.

[5] Combustible liquids are any liquids having a flash point at or above 100° F (37.8° C).

[6] According to Mike Marshall at OSHA, wipes are most likely regulated by the §1910.106 container regulations under (e)(9)(iii), which state that "combustible waste material and residues in a building or unit operating area shall be kept to a minimum, stored in covered metal receptacles, and disposed of daily."

risk to health and safety or property. The Secretary is then responsible for issuing regulations for the safe transportation of hazardous materials: the Hazardous Materials Regulations (HMR) are found in 49 CFR Parts 171-180.

According to the DOT regulations, any person who offers a material for transportation in commerce must determine whether the material is classified as a hazardous material. In most cases, reusable solvent-contaminated industrial wipes are classified as "solids containing flammable liquid, not otherwise specified" (see 49 CFR §172.101). Under §172.102, mixtures of solids and flammable liquids may be transported as "solids containing flammable liquid, not otherwise specified," without first being classified as flammable solids, provided there is no free liquid visible at the time the material is loaded or at the time the packaging or transport unit is closed (see 49 CFR §173.124(a)). Each package must correspond to a design type that has passed a leakproof test at the Packing Group II level. Containers which are authorized for transporting hazardous materials in Packing Group II are listed under 49 CFR §173.212.

Hazardous materials in Class 4.1, Packing Group II are eligible to be shipped under the limited quantity provisions of §173.151(b)(1) in inner packagings not over 1.0 kg (2.2 pounds) net capacity each, and are exempt from labeling and specification packaging requirements, provided the materials are not shipped via air. The maximum gross weight of a limited quantity package is 66 pounds. Materials shipped under the limited quantity provisions remain subject to the marking and shipping paper requirements of subparts C and D of Part 172.

According to DOT's Office of Hazardous Materials Standards, if free-flowing liquid can be seen surrounding materials that are to be shipped, the materials may meet the definition of a flammable liquid in 49 CFR 173.120. If the materials do not include free liquids, they may meet the definition of a flammable solid. Ultimately, it is the shipper's responsibility to properly classify a hazardous material.

III.B. *State Regulations*

III.B.1. *RCRA Delegation*

As mentioned previously, EPA's current policy with respect to the regulatory status of solvent-contaminated wipes is to defer the determination of regulatory status to state agencies and/or the EPA regional offices. In response, most states have developed regulatory programs that either provide conditional relief for these materials from solid waste or hazardous waste regulations or that set management standards for handlers of solvent-contaminated wipes. An overview of current state policies and programs is provided below.

III.B.2 *State Standards and Practices*

A review of state policies regarding the regulation of solvent-contaminated wipes indicates that most states have developed their own policies (pending EPA action). However, a few states have deferred regulatory decisions regarding the management of solvent-contaminated wipes to their respective EPA regional office. Currently, all states regulate industrial wipes as hazardous waste when they are contaminated with a listed solvent or exhibit a hazardous waste characteristic and the wipes are destined for disposal. Forty-six states provide regulatory relief for contaminated

wipes that are sent to an industrial laundry and subsequently reused. The remaining four states (Arkansas, Idaho, South Dakota, and West Virginia) regulate reusable wipes as hazardous waste if they contain a listed hazardous waste or exhibit a hazardous waste characteristic, even though they are being laundered.

The majority of state programs consider laundering to be a form of recycling and, subsequently, exclude reusable industrial wipes from RCRA regulation based on the state agency's interpretation of the definition of solid waste. Other states provide conditional exclusions from the hazardous waste regulations for laundered wipes. In either case, to meet the exclusion, the contaminated wipes must meet at least the following criteria:

- the wipes contain no free liquids; and
- the industrial laundry discharges to a Publicly Owned Treatment Works (POTW) or is otherwise permitted under the Clean Water Act.

States have different policies on what constitutes *no free liquids*. However, the majority of states use the Paint Filter Liquids Test (SW-846 Method 9095) to make such determinations. Other specified methods include the Liquids Release Test (SW-846 Method 9096), the TCLP (SW-846 Method 1311), and either physical or mechanical wringing until the wipe meets the "no drip" criterion. Only a few states identify wringing or solvent-extraction processes conducted by generators to remove free liquids as a form of treatment, and it is unclear whether any state defines this activity as regulated hazardous waste treatment. Several state programs specify that removing free liquids through evaporation or intentional drying is not allowed.

In many states, the burden of determining whether a solvent-contaminated industrial wipe should be managed as a hazardous waste is placed on the generator. However, some state programs specifically state that launderers are obligated to accept only contaminated wipes that meet specified criteria; otherwise, the laundry is considered a regulated disposal facility. Some states allow on-site laundering of wipes by generators, provided there is an agreement on file with the state that allows the facility to discharge to the sanitary sewer. However, the majority of states discourage on-site laundering. In addition, at least three states require contractual agreements between generators and launderers for the generator to qualify for an exclusion from RCRA regulation.

While the majority of state policies are the same, there are some states with notable variations including:

Hawaii - Reusable wipes must be managed as hazardous waste up until the point at which they are laundered.

New Mexico - Industrial laundries are subject to permitting requirements unless the wipes are placed directly into the laundry process (i.e., within 24 hours).

Idaho - Wipes must be managed as hazardous waste if they are contaminated with a listed waste or exhibit a characteristic. Reusable wipes cannot be laundered unless they are treated to meet the specified LDR treatment standard for the wastes with which they are contaminated.

South Dakota - If a listed solvent is applied to a part and then removed with a wipe, it is considered to be listed (because the solvent is "spent"), must be managed as a hazardous waste and, thus, cannot be laundered. If the wipe exhibits a characteristic, it is a regulated hazardous waste and cannot be laundered. If the wipe is contaminated with a listed solvent that was applied directly to the wipe, the wipe is not considered to meet the listing description and can be laundered without being managed as a hazardous waste.

Table 6 below provides a general overview of current state programs regarding the regulatory status of solvent-contaminated reusable and disposable wipes. Table 7 provides more specific information on a subset of state programs governing the management of wipes.

Table 6
State Policies on Reusable Wipes

State	Reusable Wipes Non-Hazardous If Water Washed Or Dry Cleaned	Disposable Wipes Considered Hazardous (Qualified)	Why Reusable Wipes Are Non-Hazardous	
			Not a Solid Hazardous Waste	Not a Waste
Alabama	Yes		Yes	
Alaska**	Yes	Yes		Yes
Arizona	Yes	Yes*	Yes	
Arkansas	No	Yes	No	
California	Yes	Yes		Yes
Colorado	Yes	Yes		Yes
Connecticut	Yes	Yes		Yes
Delaware	Yes	Yes		Yes
Florida	Yes	Yes	Yes	
Georgia	Yes	Yes	Yes	
Hawaii	Yes*	Yes		Yes
Idaho	No	Yes	No	No
Illinois	Yes	Yes	Yes	
Indiana	Yes	Yes*	Yes	
Iowa**	Yes	Yes	Yes	
Kansas	Yes	Yes*		Yes
Kentucky	Yes	Yes		Yes
Louisiana	Yes	Yes	Yes	
Maine	Yes			Yes
Maryland	Yes	Yes	Yes	
Massachusetts	Yes	Yes		Yes
Michigan	Yes	Yes		Yes
Minnesota	Yes*	Yes*		Yes

Table 5: State Policies on Reusable Shop Wipes (cont.)

State	Reusable Wipes Non-Hazardous If Water Washed Or Dry Cleaned	Disposable Wipes Considered Hazardous (Qualified)	Why Reusable Wipes Are Non-Hazardous	
			Not a Solid Hazardous Waste	Not a Waste
Mississippi	Yes		Yes	
Missouri	Yes	Yes	Yes	
Montana	Yes	Yes		Yes
Nebraska	Yes	Yes		Yes
Nevada	Yes*	Yes		Yes
New Hampshire	Yes*			Yes
New Jersey	Yes*	Yes		Yes
New Mexico	Yes*	Yes*		Yes
New York	Yes*	Yes*	Yes	
North Carolina	Yes	Yes	Yes	
North Dakota	Yes	Yes*	Yes	
Ohio	Yes	Yes	Yes	
Oklahoma	Yes	Yes*	Yes	
Oregon	Yes*	Yes		Yes
Pennsylvania	Yes*	Yes		Yes
Rhode Island	Yes*	Yes		Yes
South Carolina	Yes*	Yes	Yes	
South Dakota	No	Yes	No	No
Tennessee**	Yes	Yes	Yes	
Texas	Yes	Yes	Yes	
Utah	Yes	Yes		
Vermont	Yes	Yes		Yes

Table 5: State Policies on Reusable Shop Wipes (cont.)

State	Reusable Wipes Non-Hazardous If Water Washed Or Dry Cleaned	Disposable Wipes Considered Hazardous (Qualified)	Why Reusable Wipes Are Non-Hazardous	
			Not a Solid Hazardous Waste	Not a Waste
Virginia	Yes	Yes*	Yes	
Washington	Yes	Yes		Yes
West Virginia	No	Yes	No	No
Wisconsin	Yes	Yes	Yes	
Wyoming**	Yes	Yes	Yes	

*Note: Refer to individual state policies for qualifications.
**Note: Refer to regional policies for qualifications.

Table 7
Summary of Selected State Programs

State	Description of Policy
Alabama	Contaminated industrial wipes bound for laundering and reuse are considered products in use and are not solid wastes, and, therefore, not hazardous wastes. The state position is based upon the policy stated by Region 4.
Arkansas	Reusable industrial wipes that contain a listed waste, that are mixed with a listed waste, or that exhibit a characteristic are regulated as hazardous waste.
Florida	Reusable industrial wipes that are laundered at facilities which discharge to a POTW or are subject to the CWA are not solid wastes and are not regulated under the state's RCRA program. Florida bases its policy on the Region 4 position.
Georgia	Laundered industrial wipes are not regulated because they are being recycled and used as effective substitutes for new products according to 40 CFR §261.2(e). Generator storage prior to laundering is subject to the same accumulation requirements as hazardous waste (§262.34).
Massachusetts	Non-saturated, solvent-contaminated industrial wipes are eligible for a conditional exemption that allows them to go to laundries without a manifest, provided they meet the specified criteria. The "one drop test" is used to determine what is non-saturated (i.e., a wipe is considered saturated if a drop of solvent can be wrung out of it). Saturated industrial wipes must be managed as hazardous waste until they meet the "one drop test."
Minnesota	Free liquids must be wrung from disposable industrial wipes and must be managed as hazardous, if appropriate. Free liquids must be wrung from reusable industrial wipes and they must be managed as hazardous waste on-site. If the wipes are sent to an industrial launderer, the shipment does not require a manifest and the laundry does not need to be permitted under RCRA.
Missouri	Contaminated industrial wipes used in cleaning and degreasing operations are not regulated as solid or hazardous wastes when laundered. Industrial wipes used to clean up spills are regulated as hazardous waste if they contain a listed waste or exhibit a characteristic and laundering may be considered improper treatment. Contaminated industrial wipes that are destined for disposal must be managed as hazardous wastes if appropriate.
Nebraska	Industrial wipes used for cleaning that are contaminated with listed or characteristic solvents are not regulated as hazardous waste provided that they are being laundered (recycled) and that no free solvent is present at the time they are sent for recycling.

State	Description of Policy
New Jersey	Solvent-contaminated industrial wipes that are sent for disposal are regulated according to the mixture rule and have different standards depending on how the wipe came into contact with the solvent and the type of solvent used. If a hazardous contaminated industrial wipe is being laundered, it is not regulated as hazardous waste provided there are no free liquids. Any storage at generator facilities prior to laundering is regulated in the same manner as hazardous waste storage.
New York	Contaminated industrial wipes are not hazardous wastes when sent to industrial laundries provided they are not saturated (i.e., they pass the Paint Filter Test). Prior to laundering, all industrial wipes must be managed in accordance with specified accumulation standards. Generators also must file a one-time notice under LDR when sending industrial wipes to be laundered.
Virginia	Solvent-contaminated industrial wipes that are intended for disposal are regulated as hazardous wastes. Industrial wipes that are hazardous wastes and sent to launderers are not regulated as solid or hazardous wastes provided there are no free liquids.
Washington	Reusable industrial wipes that would be hazardous wastes are not regulated as hazardous waste if they are managed according to the established best management practices (i.e., no free liquids, closed container, permitted laundry facility, etc.). Hazardous waste wipes that are sent for disposal are subject to regulation.
West Virginia	Industrial wipes contaminated with a listed hazardous waste or that exhibit a characteristic are subject to regulation as solid wastes. Industrial wipes are viewed as spent materials and as such are solid wastes when reclaimed.

IV. Provisions of the Proposed Rule

This section of the Technical Background Document is designed to provide supplemental information to the discussion of the provisions of the proposed rule available in the Preamble. All the provisions and conditions are outlined here, but if there is no discussion in addition to what is in the Preamble, the appropriate Preamble section is simply referenced to avoid unnecessary repetition.

IV.A *Proposal Summary*

In response to public comment, regulatory interpretation requests, several regulatory petitions, and issues raised during the Printing Sector meetings of EPA's Common Sense Initiative (CSI), EPA is proposing to clarify the regulatory status of solvent-contaminated industrial wipes. The Agency is proposing to modify the RCRA hazardous waste management regulations for certain solvent-contaminated materials, including reusable shop towels, rags, disposable wipes, and paper towels. This proposed rule would encourage resource conservation and responsible solvent management and would remove potential regulatory impediments to solvent recovery. Specifically, EPA proposes to–

(1) Conditionally exclude from the definition of hazardous waste disposable industrial wipes that are contaminated with hazardous solvents and are sent for disposal to a municipal or other non-hazardous waste landfill or a combustion facility.

(2) Conditionally exclude from the definition of solid waste reusable industrial wipes that are contaminated with hazardous solvents and are sent for laundering or dry cleaning.

The conditions that would be required for the exclusions are discussed later in this section of the technical background document.

The proposed rule affects contaminated wipes that are sent to both landfills and non-landfill facilities (e.g., laundries and combustion) and applies to (1) industrial wipes exhibiting a hazardous waste characteristic (i.e., ignitability, corrosivity, reactivity, or toxicity) due to use with solvents and (2) industrial wipes contaminated with F001-F005 spent solvents or comparable P- and U-listed commercial chemical products that have been spilled and cleaned up.

IV.B *Intent of the Proposed Rule*

Current federal policy enables EPA regional officials and state program officials to make case-specific interpretations of the regulatory status of solvent-contaminated industrial wipes. This policy has resulted in some states and regions invoking the hazardous waste mixture rule or the contained-in policy to interpret the status of these industrial wipes. However, many states provide a conditional exclusion from the definition of solid waste for reusable wipes that are managed at industrial laundries or industrial dry cleaners. Many state programs provide that solvent-contaminated industrial wipes sent off site to be managed at an industrial laundry or industrial dry cleaner are not a hazardous waste (or even a solid waste in some states) as long as the wipes do not contain free liquids and are sent to a facility that is permitted to discharge to a

publicly owned treatment works (POTW).

Through this proposed rule, EPA aims to resolve, at the federal level, some long-standing issues associated with the management of solvent-contaminated industrial wipes. One important way the proposal attempts to do this is by facilitating pollution prevention and waste minimization, including the recycling of spent solvents extracted from contaminated industrial wipes. The proposed rule also–

(5) Fosters improved solvents management by generators and handling facilities;

(6) Reduces compliance costs for many facilities using these materials;

(7) Increases consistency in the regulations governing solvent-contaminated industrial wipes across the U.S. and clarifies existing federal rules and their interpretations;

(8) Addresses longstanding industry petitions to EPA; and

(9) Creates flexibility for generators to work with industrial laundries, as appropriate, to ensure compliance with local pretreatment standards established by publicly owned treatment works (POTWs).

This rule would foster pollution prevention and waste minimization opportunities by encouraging users of industrial wipes who desire less stringent management requirements to use alternative solvents, use less solvent, or remove solvents from the wipes to meet the “no free liquids” or “dry” conditions, as discussed later in this section. For instance, generators who want to dispose wipes containing listed solvents or wipes exhibiting a hazardous characteristic in a landfill must either use alternative solvents or reduce the amount of solvent contained in the wipe to a dry state. Because opportunities exist for recycling and reusing hazardous solvents contained on disposable or reusable wipes, in many instances, advanced solvent extraction and recovery technologies can result in opportunities to reduce pollution and increase profits for generators and handlers. Pollution prevention opportunities are discussed further in section IV.B.1.

Industrial wipes are a versatile product. Thousands of facilities use hundreds of millions of wipes containing hazardous solvents every year. EPA estimates that 3.1 billion wipes containing approximately 75,000 to 100,000 tons of solvent are used annually. This rule is intended to foster greater understanding of the regulations and improvements in management of solvent-contaminated wipes by generators and handling facilities.

By reducing compliance costs, this rule would also provide regulatory relief. In some situations, current federal rules appear to over-regulate these materials, such as when very small amounts of hazardous solvent are applied to industrial wipes. Therefore, EPA believes an alternative regulatory program can be designed specifically for these materials that makes more sense in their market without compromising human health and the environment.

The proposed rule clarifies problems with existing federal rules and state policies. Current rules and policies associated with solvent-contaminated industrial wipes are inconsistent and

sometimes result in mismanagement of these materials. For instance, some regions and states have interpreted RCRA rules to say that solvent-contaminated reusable industrial wipes are not solid wastes (under RCRA, a secondary material cannot be a hazardous waste without first being a solid waste). As a result, these materials are not subject to RCRA regulation at all, and therefore can potentially be managed in ways that are not environmentally sound.

Prior to initiating a proposed rulemaking, EPA's Office of Solid Waste (OSW) conducted screening analyses to determine the potential risks to human health and the environment from the potential mismanagement of solvent-contaminated industrial wipes. In addition, EPA investigated the potential number of facilities that may be impacted by any regulatory change and the potential changes in compliance costs that may be associated with any regulatory modifications. A summary of the results of the risk analysis is presented in section 5 of this technical background document and the risk report and the economics background document are available in the docket for this proposal. The results of the Agency's investigation into risks from solvent-contaminated industrial wipes indicate that industrial wipes containing some F-listed solvents may pose potential risks to human health when managed in an unlined landfill. However, the Agency found that other types of F-listed solvents may pose very little or no risk if disposed in small quantities in municipal solid waste landfills.

The proposed rule would allow generators more flexibility to work with industrial laundries, as appropriate, to ensure compliance with local pretreatment standards established by publicly owned treatment works (POTWs). EPA concluded that, to the extent isolated problem discharges occur, existing pretreatment authority allows local POTWs to respond to problems effectively.

Finally, the proposal provides a tentative response to petitions filed by the Kimberly-Clark Corporation in March 1985 and Scott Paper Company in May 1987 regarding the application of the federal regulations to disposable wipes containing hazardous waste solvents.

IV.B.1. *Pollution Prevention*

Facilities using hazardous solvents in conjunction with disposable or reusable wipes can use various industry and government sources to assist them in identifying alternative solvent sources that are effective substitutes with no risks to human health and the environment (see, for instance, EPA's Design for the Environment website: <www.epa.gov/dfe>). In fact, research may yield alternatives to solvents that are cheaper to purchase than the original, or for which the total life-cycle management of the alternative solvent is cheaper than the original when compliance with air, water, and waste regulations is factored in.

Another option is for firms using hazardous solvents in conjunction with industrial wipes to evaluate whether particular processes can be modified or re-engineered to eliminate the need for wiping or cleaning operations. Again, various resources exist for companies to examine the possibility of eliminating or modifying existing operations such that the need for solvent wipes disappears.

EPA noticed at a few site visits that the amount of solvent applied to a wipe far exceeded

the amount of solvent actually needed to perform a particular cleaning operation. If a facility must use a hazardous solvent, potential risks to human health and the environment, as well as potential compliance costs, can be reduced by applying less solvent and possibly reusing the wipe. Both approaches reduce solvent usage and, therefore, reduce solvent purchasing costs and waste/material management costs. Firms should examine their solvent use practices to determine if less solvent and fewer industrial wipes can be used to perform particular cleaning operations.

If pollution prevention techniques are not feasible, generating facilities might be able to recycle and reuse the spent solvent contained on their wipes in other ways. First, several existing facilities such as Brent Industries, and Industrial Towel and Uniform can clean contaminated or soiled wipes and recycle the solvent extracted or distilled from their cleaning processes.[7] Brent Industries operates a distillation process that can produce (regenerate) solvents meeting the product specifications of the originating companies. Second, integrated industrial wipe cleaning/solvent recovery technologies can be installed by firms such as Maratek. Used primarily by high-volume wipe-generating firms, such as printers and newspapers, solvent recovery technologies can yield a return on investment within two years for some firms by reducing solvent purchasing and waste management costs. Another solvent recovery technology is microwave, where the solvent is dried down, captured and introduced back into the manufacturing process. Some firms have the flexibility of installing their process on site or adjacent to an industrial laundry where solvent can be extracted from soiled reusable wipes, regenerated, and returned to the originating company. The soiled wipes (minus the solvent) can then be washed and returned to the originating company.

As with pollution prevention, economics plays an important part in determining whether to recycle the solvent or maintain current operating practices. However, if a facility uses a large number of wipes and applies considerable amounts of solvent to each wipe, it is likely that pollution prevention can increase profit and reduce pollution, particularly if the cost of purchasing the solvent is considerable.

IV.C. *Eligibility for Exclusions*

To be eligible for the proposed exclusions, a facility must meet a number of conditions. As long as the specified conditions are met, the Agency proposes that both exclusions apply to the following:

(1) Industrial wipes exhibiting a hazardous waste characteristic (i.e., ignitability, corrosivity, reactivity, or toxicity)[8] due to use with solvents; and

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[7] Descriptions of companies or technologies found in this technical background document are for descriptive purposes only and are not an endorsement of the products themselves.

[8]Solvent-contaminated industrial wipes that are co-contaminated with another material that makes them characteristically hazardous for corrosivity, reactivity, or toxicity would not be eligible for the exclusion from the definition of hazardous waste or the exclusion from the definition of solid waste. If the industrial wipes are co-contaminated with a material that makes them characteristically hazardous for ignitability, they would remain eligible. For more discussion of this provision, see Section V.B.11 of the proposed rule.

(2) Industrial wipes contaminated with F001-F005 spent solvents or comparable P- and U-listed commercial chemical products that are spilled and cleaned up.

This proposal would not affect the regulatory status, under federal regulations, of conditionally exempt small quantity generators (CESQGs)– those that generate no more than 100 kilograms of hazardous waste or no more than one kilogram of acutely hazardous waste in a month and who accumulate no more than 1000 kilograms of hazardous waste or no more than one kilogram of acutely hazardous waste at one time.

EPA's concern surrounding the use of both disposable and reusable industrial wipes is based on the hazardous solvent contained in the used wipes, not the industrial wipes themselves. This proposed rule would not apply to industrial wipes contaminated with solvents that, when spent, are not hazardous wastes. EPA recommends that generators examine the feasibility of substituting non-hazardous solvents for hazardous solvents in order to avoid concerns regarding management of hazardous waste.

IV.D. *Proposed Conditions for Exclusion from Definition of Hazardous Waste for Disposable Solvent-Contaminated Industrial Wipes*

IV.D.1. *Proposed Conditions for Initial Storage and Accumulation*

Proposal

The proposed conditional exclusion from the definition of hazardous waste would apply to solvent-contaminated disposable industrial wipes at the point when the wipes are discarded by the generator. If the wipes are managed according to the proposed conditions, they will not be considered hazardous waste. EPA's proposal establishes a condition for the on-site accumulation and storage of solvent-contaminated wipes that requires the use of non-leaking, covered containers. Generators must accumulate and store solvent-contaminated wipes in covered containers that do not allow solvent to be released from the container. The container must not leak liquids and must protect against fugitive air releases of solvents when not in use. These conditions provide flexibility while reducing the threat of fire and protecting the environment and health and safety of workers.

Discussion

Site visits conducted by EPA in 1997 provided evidence that both open and closed containers are used for the accumulation of solvent-contaminated industrial wipes. The most common management practices involved the use of a wide variety of containers, ranging from approximately five gallons in size (e.g., safety cans) to 55-gallon drums. Some sites also used safety cans as satellite accumulation units from which the wipes were later transferred to a centralized accumulation unit. Many facilities stored solvent-contaminated industrial wipes in screen-bottom drums to reduce the amount of free liquids in the materials. Some facilities also used plastic bags as on-site accumulation units. The performance-based condition proposed by EPA accommodates the needs of workers constantly needing to open the drum and provides flexibility by allowing generators to accumulate solvent-contaminated industrial wipes in any of

these containers that prevent air releases when not being used. Under the proposed rule, generators may take innovative approaches to meet the performance standard being sought rather than being required to use a specific design. A performance standard also provides a degree of flexibility in terms of allowing different approaches that minimize the length of time required for workers to place a used industrial wipe in a storage container. This requirement also reflects the spirit and intention of OSHA regulations. Generators who already meet OSHA container standards should meet the proposed requirement for the safe on-site storage of solvent-contaminated industrial wipes.

Requiring the use of covered containers during on-site accumulation and storage of solvent-contaminated wipes should significantly reduce any health and safety risks associated with worker exposure to vapors through volatilization from solvent-contaminated wipes. Many trade associations encourage their clients to use covered containers for the on-site storage of solvent-contaminated industrial wipes. Similarly, some states require the use of closed containers and may specify more stringent container management standards. In the case of disposable solvent-contaminated industrial wipes, almost all states currently regulate these materials as hazardous waste; therefore, containers used to accumulate these wipes at generator facilities are currently subject to the hazardous waste container standards in 40 CFR part 265, subpart I.

Alternate Option–Accumulation Time Limit

EPA is considering including a condition that establishes a time limit for accumulation of solvent-contaminated disposable wipes at a generator facility, so they cannot be kept on site indefinitely without management. This condition would be that solvent-contaminated disposable wipes being accumulated at the generator under the conditions proposed must also follow the accumulation time limits in 40 CFR 262.34 that are applicable for their generator category (i.e., 90 days for large quantity generators (LQGs) and 180 days for small quantity generators (SQGs)). In addition to following the time limits in 262.34, generators would have to mark any container in which solvent-contaminated disposable industrial wipes were being accumulated with a label stating that it holds excluded solvent -contaminated wipes and stating the date accumulation started.

Although this option would require generators to follow the appropriate time limit for their generator size, because the industrial wipes are excluded from the definition of hazardous waste from the point of generation, they would not have to be added to the generators counting of hazardous waste. In other words, generating solvent-contaminated wipes under the conditions of the proposal would not cause a facility to move from being an SQG to being an LQG.

Alternate Option - No RCRA-Specific Condition

The Agency also is considering not establishing a specific accumulation condition under RCRA, but relying on other regulatory statutes, like the Occupational Safety and Health Act (OSHA).

OSHA’s occupational health and safety standards, found under 29 CFR part 1910, provide both general and specific requirements for the storage of hazardous materials in the workplace. The following discussion provides an overview of OSHA regulations and the applicability of each

regulation to solvent-contaminated wipes.

OSHA's Hazard Communication Standard, 29 CFR 1910.1200

OSHA's Hazard Communication Standard (HCS) was promulgated to ensure that pertinent information regarding the risks from hazardous materials in the workplace is conveyed to the workers whose responsibility it is to handle or come in contact with these hazardous materials. 29 CFR 1910.1200(d)(1) requires "chemical manufacturers and importers to evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement." Similarly, 29 CFR 1910.1200(d)(2) states that "chemical manufacturers, importers or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards."

29 CFR 1910.1200(e)(1) requires employers to develop, implement, and maintain a written hazard communication program at each workplace. The program, at a minimum, must describe how the criteria associated with labeling, Material Safety Data Sheets (MSDSs), and employee information and training shall be met. The premise of this regulation is that workers who understand the hazards associated with a material will be more likely to handle the material in a safe manner.

Each chemical product used in a facility, whether it is hazardous or contains hazardous chemicals, has an MSDS associated with it. MSDSs give detailed information about products, chemicals in the products, hazards, and handling specifications. Chemicals must be handled in accordance with MSDS information, and under the HCS, employees are required to be educated about the MSDS information. MSDSs may require that particular chemicals or products be stored in closed containers and/or stored in a cool place. Almost all solvents that are RCRA listed or characteristic hazardous wastes when they are spent would probably require an MSDS.

All facilities that use hazardous chemicals are required to conduct employee hazard training. The comprehensive hazard communication programs disseminate any health or physical hazard information associated with chemicals and products used at the facility. These programs also include information about container labeling requirements, MSDSs, and other employee safety training. According to the OSHA interpretation of the HCS regulations, all containers of hazardous chemicals in the workplace must be labeled either as hazardous or with a description of the specific contents of the container.

OSHA Permissible Exposure Limit Regulations

OSHA regulations under 29 CFR 1910 subpart Z support and reinforce the HCS. These regulations address exposure to numerous chemicals that pose unacceptable health risks to workers (usually based on an 8-hour shift in a 40-hour work week). OSHA currently has 470 permissible exposure limits for various forms of approximately 300 chemical substances. Facilities managing solvent-contaminated industrial wipes may be subject to these requirements and exposure limits.

OSHA 29 CFR 1910.106 - Management Standards for Flammable and Combustible Liquids

29 CFR 1910.106 requires the proper management and storage of flammable[9] and combustible[10] liquids in the workplace. The requirements for flammable and combustible liquids are based on the National Fire Protection Association's Flammable and Combustible Liquids Code - NFPA 30.

According to OSHA standards, flammable liquids must be stored in approved containers which meet the requirements of 29 CFR 1910.106(d). Metal containers and portable tanks meeting Department of Transportation standards (see 49 CFR part 173 and 178) are acceptable. Section §1910.106 also specifies standards for the areas where containers holding flammable liquids will be stored, including requirements for storage cabinets, rooms, buildings, storage outside of buildings, and industrial plants.[11] However, the management of solvent-contaminated wipes is most likely subject to container regulations under 29 CFR 1910.106(e)(9)(iii), which state that "combustible waste material and residues in a building or unit operating area shall be kept to a minimum, stored in covered metal receptacles and disposed of daily."

Industry-Specific OSHA Standards

OSHA also has developed specific industry regulations for the protection of worker health and safety. For example, 29 CFR part 1926 provides health and safety standards for construction. The standards apply to activities associated with "construction, alteration, and/or repair, including painting and decorating." OSHA mandates that, when disposing of waste materials, "all solvent waste, oily rags, and flammable liquids shall be kept in fire-resistant, covered containers until removed from the worksite."

Similarly, 29 CFR part 1915 provides Occupational Safety and Health Standards for Shipyard Employment. subpart F regulates General Working Conditions and, specifically, "Housekeeping." These standards mandate that for ship repairing and shipbuilding, "all oils, paint thinners, solvents, waste, rags, or other flammable substances shall be kept in fire-resistant, covered containers when not in use."

Finally, OSHA Section 4(b)(1) defers to other statutes the storage and management of hazardous materials or hazardous waste when regulations are in place. Thus, DOT and RCRA regulations supersede OSHA regulations, where applicable.

EPA believes there may be gaps in coverage if the proposed regulation were to rely strictly on the OSHA regulations. For example, the OSHA container standards may not apply to contaminated wipes with no free-flowing liquids or when wipes are contaminated with solvents

[9] Flammable liquids are defined as any liquids having a flash point below 100° F (37.8° C).

[10] Combustible liquids are any liquids having a flash point at or above 100° F (37.8° C).

[11] Discussion with Mr. Matt Stein of OSHA's Hotline on January 22, 2002.

that would be RCRA hazardous but not meet the OSHA definition of flammable or combustible. Many facilities either generating or handling solvent-contaminated wipes should already be subject to these standards and, as a result, deferring to OSHA standards would be simple. For them, however, the OSHA regulations might mandate that containers be sealed, removing some of the flexibility of EPA's proposal.

IV.D.2. *Proposed Conditions for Containers Used for Transportation*

Proposal

EPA is proposing a container condition for generators who transport solvent-contaminated industrial wipes off site under the conditional exclusion. This condition will ensure that transporting the wipes without full RCRA hazardous waste requirements will still protect against risks posed by these materials to human health and the environment. Under this proposal, generators must transport industrial wipes in containers that are designed, constructed and managed to minimize loss to the environment. In proposing this condition, EPA envisions containers that do not leak liquids and that provide for control of air emissions.

EPA would consider hazardous solvents that are spilled or leaked during transportation to be disposed. Therefore, the party managing the industrial wipes at the time the spill occurred would be responsible for cleaning up the spill and managing those materials appropriately.

Discussion

This condition is designed to minimize loss of solvent to the environment during transportation and, therefore, to minimize environmental risk as well. Minimizing loss through evaporation or leakage also makes it more likely that larger quantities of solvent will be recycled or otherwise properly managed. This provision, implementation questions, and other options are discussed in the preamble to this proposal.

IV.D.3 *Proposed Labeling Condition for Containers Used to Transport Disposable Wipes*

Proposal

EPA is proposing a labeling requirement that would require the use of specific language or a pre-made label, such as "Excluded Solvent-Contaminated Wipes," to be applied to each container used to accumulate and/or store solvent-contaminated industrial wipes, unless the wipes are being recycled. This type of requirement is comparable to the used oil labeling requirement in 40 CFR part 279.

Discussion

Under this option, labels regarding the excluded status of the wastes would provide information to downstream handlers of the materials. The labeling designates the materials as excluded from hazardous waste management requirements which would clarify the status of the

wipes clear to handlers so they know they meet the conditions of the exclusion and, therefore, do not need to be managed as hazardous waste.

A label also informs workers of what materials they are handling, so that they can use proper handling procedures. To accomplish this at the point of generation, during transport, and during management, the container in which the wipes are placed and transported should be labeled. In addition to accumulation at the point of use, wipes may also come in contact with other containers at the generator location or in subsequent handling, on site or off site. Labeling containers helps ensure that the materials inside can be easily identified and, therefore, managed properly.

This option provides a simple solution to labeling while allowing generators to indicate that the condition is met. It would allow handlers to differentiate between regulated and excluded industrial wipes and handle them accordingly. However, the "excluded" designation added to the containers raises a question of whether a hazardous waste stigma would remain attached to the industrial wipes, regardless of their status, and still render them subject to more expensive waste management and handling after they leave the generator site.

Alternate Option - No RCRA-Specific Labeling Condition

Another option EPA is considering is not to impose a specific labeling requirement. Under this approach, designation of the disposable industrial wipes as hazardous materials under DOT regulations might still require placarding or other marking for transportation of some fraction of these materials, as described previously. However, for the reasons explained above, we do not expect that the DOT provisions would apply to all solvent-contaminated industrial wipes covered by the proposal. This option is simple to implement and easy for generators to understand because it follows current labeling requirements without introducing a new designation for the wastes. Once the contaminated materials meet the performance standards and the materials are excluded from regulation as a hazardous waste, RCRA labeling requirements would no longer apply.

Existing regulatory programs administered by DOT and OSHA already prescribe labeling requirements for container storage and transportation. Title 40 CFR (Environmental Protection) parts 260-264, Title 49 (Transportation) parts 171-173, and Title 29 (Labor) section 1910.1200 all contain regulations pertaining to management of hazardous materials, including labeling requirements. Most of the labeling requirements (e.g., 40 CFR 262.31) relate to conditions for hazardous waste transportation and many refer to the DOT regulations found in 49 CFR 172, which require marking (written information that varies depending on the characteristics of the waste), labeling (where the specific wording and/or label is provided) and placarding (where specific placards are used on the outside of vehicles).

The OSHA standards in 29 CFR 1910.1200 require containers in the workplace to be marked with the identity of the hazardous chemicals contained within and appropriate hazard warnings that clearly convey the risks that the chemicals pose before the containers are offered for transport. Some states also require that containers with solvent-contaminated wipes be marked with the date of the beginning of accumulation. In addition, OSHA standards state that "Unlabeled drums and containers shall be considered to contain hazardous substances and handled

accordingly until the contents are positively identified and labeled" (29 CFR 1910.1200(j)(1)(ii)).

EPA could emphasize this regulation in its proposed rulemaking, which would avoid the establishment of duplicative regulations. On the other hand, DOT's regulations for all non-bulk hazardous materials being transported require the following:

- A generator who offers hazardous waste for transportation must mark each package, freight container, and transport vehicle in a specific manner. Many pre-made stickers and placards describe the dangerous characteristics of hazardous materials. The labels must be displayed prominently and clearly, and to the specifications laid out for each container or vehicle in 49 CFR 172.

- The proper shipping and ID number must be included with each package for the hazardous material being transported as shown in the table in 49 CFR 172.101. If more than one hazardous substance is being carried in the same package, at least two materials, those with the lowest reportable quantities, must be identified. Technical names of the hazardous materials must be included.

- Exempt packages must be marked "DOT-E," along with the assigned exemption number.

- The cosigner or cosignee's name and address must be marked on the package, except for in certain circumstances (see 49 CFR 172.301(d)).

- A generator must mark each hazardous waste container of 110 gallons or less with a warning, the generator's name and address, and the manifest number before transport off site.

- All vehicles transporting hazardous materials, except those materials classified as "Other Regulated Materials," must have placards in specified places in accordance with the characteristics of the transported hazardous wastes. A vehicle used to transport two or more hazardous materials that require different placards may instead use a DANGEROUS placard, so long as a total of less than 2,268 kg (5,000 lbs.) of hazardous material is carried. Vehicles carrying less than 454 kg (1,000 lbs.) aggregate gross weight of hazardous materials are not required to have a placard.

IV.D.4. *Proposed Condition for Transportation to a Municipal or Other Non-Hazardous Landfill*

Proposal

This proposed rule allows solvent-contaminated wipes to be disposed in a municipal subtitle D landfill or other non-hazardous waste landfill[12] if they meet a condition for being "dry," meaning that each wipe contains less than 5 grams of solvent. Because of the risks of certain

[12]For the purposes of this proposal, EPA uses the term *other non-hazardous landfill* to denote part 257 subpart B compliant non-hazardous waste landfills. If a non-hazardous landfill that is not a municipal landfill accepts this waste, it must meet the minimum standards of 40 CFR part 257 subpart B.

highly toxic F-listed solvents, however, EPA is proposing to make 11 F-listed solvents ineligible for this option, meaning that wipes containing these constituents cannot be disposed in a municipal landfill even if they meet the "dry" condition. Because of these concerns, EPA is proposing that industrial wipes that are contaminated with the F-listed solvents specified in Table 8 cannot be disposed in municipal or other non-hazardous waste landfills.

Table 8
F-Listed Solvents That May Not Be Disposed in Municipal or Other Non-Hazardous Waste Landfills

Benzene*	2-Nitropropane
Carbon tetrachloride*	Nitrobenzene*
Chlorobenzene*	Pyridine*
Cresols (o,m,p)*	Tetrachloroethylene*
Methyl ethyl ketone (MEK)*	Methylene chloride
Trichloroethylene*	

* Solvent meets the toxicity characteristic.

Table 9 contains the 19 F-listed solvents that were evaluated in EPA's risk screening analysis and that would be allowed, under this proposal, to be disposed in a municipal or non-hazardous waste landfill if they meet the "dry" condition. See section 5 for additional details on the results of EPA's risk screening analysis.

Table 9
F-listed Solvents That May Be Disposed in a Municipal or Other Non-Hazardous Waste Landfill

Ethyl Ether	Carbon Disulfide	Isobutyl Alcohol	1,2-Dichlorobenzene
Acetone	Xylenes	Ethyl Acetate	1,1,2-Trichlorotrifluoroethane
Methanol	Cyclohexanone	Trichlorofluoromethane	1,1,1-Trichloroethane
Butanol	2-Ethoxyethanol	Methyl Isobutyl Ketone	1,1,2-Trichloroethane
Toluene	Ethyl benzene	Dichlorodifluoromethane	

Discussion

In developing this option, EPA realized that the hazardous constituents present in F-listed solvents each have different toxic effects, as detailed in the risk screening analysis presented in Section 5 of this technical background document. This risk screening suggests to EPA that materials contaminated with certain solvents can be disposed safely in municipal landfills, that additional caution is required for others, and that a third category of contaminants is sufficiently toxic that solvents containing them should be ineligible for disposal in municipal landfills.

The results of the risk-screening analysis suggest that situations exist where disposable wipes contaminated with some F-listed hazardous waste solvents could be managed in a municipal solid waste or other non-hazardous waste landfill without posing a risk to human health, particularly if some level of solvent removal is achieved prior to disposal. However, other F-listed solvents used in conjunction with disposables (see Table 8) pose potential health risks even in small amounts. EPA has tentatively concluded that the solvents listed in Table 8 may pose an unacceptable risk to human health and the environment when disposed in such landfills.

Nine of the solvents in Table 8 are toxicity characteristic constituents, as defined in 40 CFR 261.24. EPA's analysis finds that the levels of these solvents in contaminated industrial wipes, even when they have been through solvent extraction and contain less than five grams of solvent per wipe, are likely to be higher than the regulatory levels indicated in 40 CFR 261.24. Therefore, these TC solvents are ineligible for disposal in municipal and other non-hazardous waste landfills because of their potential risk, as determined when they were originally identified by EPA as TC wastes. Six of these nine are ineligible just due to their status as TC wastes. The other three (methyl ethyl ketone, nitrobenzene, and pyridine), in addition to being TC, triggered an ineligible rating on EPA's risk screening analysis. If land-disposed, industrial wipes contaminated with these 11 solvents would have to continue to be managed in full compliance with RCRA subtitle C hazardous waste management standards, including the land disposal restrictions.

EPA is proposing that disposable wipes contaminated with F-listed solvents other than those in Table 8 can be managed in municipal solid waste landfills once the wipes meet the "dry" condition. However, if the wipe is contaminated by a listed hazardous waste other than F001 through F005, the wipe cannot be disposed in a non-hazardous waste landfill. EPA is limiting the exclusion because insufficient data exists at this time to show that wipes contaminated with such materials would not pose a significant threat to human health and the environment if managed in a municipal solid waste landfill.

"Dry" Condition

Generators transporting their disposable industrial wipes to a municipal or other non-hazardous waste landfill must ensure that the wipes are dry. For purposes of this proposed rule, an industrial wipe is considered "dry" when it contains less than five grams of solvent. EPA chose five grams because it falls within the range found in our risk screening analysis to be protective of human health and the environment. Five grams is also within the range of what is achievable through use of advanced solvent-extraction processes. Generators can meet this condition either by using less than five grams of solvent on each wipe or by putting used industrial wipes through a solvent extraction process capable of removing sufficient solvent to meet the 5-gram condition.

EPA considered requiring centrifuging as the only method to meet the dry condition. However, EPA was concerned that simply requiring centrifuging could allow poorly operated or poorly constructed units to be used to meet the requirements. EPA's data on centrifuges indicates that, in general, they allow for high solvent extraction. EPA has analyzed data demonstrating removal efficiencies for hand wringing, mechanical wringing, screen bottom drums, and centrifuging. Centrifuging was found to remove the greatest quantity of solvent. EPA's

demonstration data showed that a properly operated centrifuge results in removal efficiencies of 76 to 99 percent. This is much more efficient than the next-most efficient technology tested by EPA, mechanical wringing, where removal efficiency seldom exceeded 30 percent. However, EPA only observed centrifuges in use in the printing industry, with only a small percentage of generators using the technology. Additionally, although centrifuging is reported to be used for both launderable and disposable wipes, EPA lacks specific data on all of the types of disposable wipes that could be used by industry. However, based on site visits, EPA is confident that a well-operated centrifuge will meet the 5-gram condition in this proposal.

The Agency also recognized that there may be other high-efficiency solvent removal technologies currently on the market or under development that could achieve removal efficiencies similar to or better than centrifuging. The Agency wants to provide generators with flexibility to employ effective technologies and is proposing to allow the use of other technologies that can achieve high rates of solvent removal. Generators who do any of the following will be considered to have met the "dry" condition:

- Remove excess solvents by centrifuging or other high-performance solvent extraction or removal technology, for example, microwave solvent recovery processes or the Petro-Miser or Fierro processes;[13]

- Use normal business records, such as the amount of solvent used per month for wiping operations divided by the number of wipes used per month for solvent wiping operations, to show they are under the threshold;

- Conduct sampling to measure the amount of solvent applied per wipe before use; or

- Sample to measure the amount of solvent remaining on wipes when use is completed.

Testing and extraction technologies are described in greater detail in Section IV.F.5, in discussion of the free liquids condition.

IV.D.5. *Proposed Condition for Transportation to Non-Land Disposal Facilities*

Proposal

EPA is proposing a "no free liquids" condition for solvent-contaminated industrial wipes sent for disposal at a non-land disposal unit such as a municipal waste combustor (MWC) or other combustion unit, including use as a fuel. This condition would also apply to solvent-contaminated industrial wipes sent to an intermediate handler for further processing to meet the "dry" condition before disposal in a municipal or other non-hazardous waste landfill. This condition is meant to minimize the likelihood of solvent loss into the environment, as well as to encourage solvent recovery and pollution prevention by generators.

[13] Descriptions of these technologies in the Technical Background document are for descriptive purposes only and is not an endorsement of the products themselves.

To meet the "no free liquids" condition, no liquid solvent may drip from the wipes before they are sent off site or while they are in transit to a handler or disposal site and there may be no free liquids in the drum. In this proposal, EPA intends for compliance with the "no free liquids" condition to be determined by a practical test. That is, does liquid drip from a wipe when it is held for a short period of time (e.g., when being transferred from one container to another)? This and other tests are described in detail below.

The proposed rule contains the provision that, if free liquids are discovered at the handling/combustion facility, the solvent-contaminated wipes would remain excluded from the definition of hazardous waste as long as the handler either removes the solvent and manages it properly or returns the shipment to the generator as soon as reasonably practicable, as described in Section V.B.10.a. of the preamble.

Note that handlers would be required to determine whether the solvent which has been removed from the industrial wipes is listed as a hazardous waste or exhibits a characteristic as defined in 40 CFR part 261. Any hazardous waste solvent removed from the wipes would have to be managed in accordance with hazardous waste requirements found at 40 CFR parts 260-268 and 40 CFR part 270. However, for purposes of this proposed regulation, techniques or technologies used by generators to remove solvent from the wipes would not be considered *treatment* and would not be subject to permitting.

Discussion

One concern certain stakeholders have expressed with this proposed condition is that once in a container, either at the generator site or in transit, industrial wipes can compress and solvent can percolate through them, collecting at the bottom of a container. This means that, while there may not have been free liquids in the container at the generator site, some may be generated during transportation. EPA acknowledges that compression can result in free liquids percolating to the bottom of a container.

Determining Whether the "No Free Liquids" Condition Has Been Met

Under the option proposed, the "no free liquids " condition can be met by employing any of the following practices: hand-wringing; use of a properly operated screen-bottom drum; mechanical wringing; centrifuging; use of an enclosed, controlled air dryer with exhaust vents to recycle the recovered solvent; solvent removal and/or recycling using low-pressure evaporation; microwave or elevated-temperature technology; combinations of these techniques/technologies; or any technology or process that assures free liquids will not be released from the wipes or released into the environment during the process. These technologies are more thoroughly described below. In addition, generators who know, in their best professional judgement, that their processes do not use enough solvent per wipe to produce free liquids can rely on that knowledge. The use of air drying to pass the test is not allowed. If alternative technologies are used, the generator is responsible for determining that no solvent drips from the wipe and that containers do not have free liquids in them, as described above.

This option will allow generators to select the most appropriate solvent removal

technology for their particular solvent-contaminated industrial wipes. Generators would be able to demonstrate that their solvent-contaminated wipes do not contain free liquids through–

- Physical examination of wipes stored in containers prior to being sent off site;
- Examination of on-site technologies; or
- Inspection of contractual agreements with outside parties who travel to work sites and use solvent-extraction technologies on wipes.

Promulgation of this option is consistent with existing state guidance, which often requires generators to ensure that shipments of solvent-contaminated wipes do not contain free liquids, although some states require the use of the Paint Filter Liquids Test (SW-846 Method 9095) or other state-developed tests.

Existing Tests for Determining "No Free Liquids"

RCRA regulations include a number of definitions which rely on the term "liquid." One definition is set forth within the context of the hazardous waste identification criteria of 40 CFR part 261. In using the Toxicity Characteristic Leaching Procedure (TCLP)(Method 1311), generators can determine whether their waste is a "liquid" by evaluating certain results of SW-846 Method 1310. "Liquid" refers to the portion of the waste sample that is expressed from the waste. If the solid residue obtained after the separation step is less than 0.5 percent of the original weight of the sample, then the generator must treat the liquid portion of the waste as the extract. Under 40 CFR 258.28, wastes are prohibited from disposal in a municipal solid waste landfill if the waste contains free liquids. 40 CFR Section 258.28 directs generators to use the Paint Filter Liquids Test to determine whether a waste contains free liquids. RCRA also prohibits the placement of hazardous wastes containing free liquids in a hazardous waste landfill and prohibits the use of sorbents to solidify a liquid waste if the solidified waste releases the contained liquids under landfill pressures. 40 CFR Sections 264.314 and 265.314 require the use of the Paint Filter Liquids Test as the determinative method for releasable liquids.

With respect to reusable wipes, the states have different policies on what constitutes no free liquids; however, the majority of states require the Paint Filter Liquids Test for such determinations. Other specified methods include the Liquids Release Test (SW-846 Method 9069) and the TCLP. The following sections describe these analytical tests for determining "no free liquids," and provide some discussion on the applicability of these tests to solvent-contaminated wipes.

Physical Examination

The simplest technique that many facilities use is to examine a sample of wipes stored in the bottom of the container immediately prior to subsequent handling–either on site or off site. If the amount of solvent applied to the wipe is small (five to ten grams), then there is a very good chance that no free liquids will be present on the wipe or in the container. Therefore, generators using small amounts of solvent can check their compliance with physical examination of their

wipes.

Paint Filter Liquids Test

The Paint Filter Liquids Test, SW-846 Method 9095, is a laboratory method used to determine the presence of free liquids in a waste sample. The waste sample is placed in a conical paint filter suspended in a ring stand. The paint filters are typically fine meshed size. To test for the removal of free liquids, the waste sample is weighed prior to testing to determine the amount of absorbed liquid and then placed in the paint filter. If liquid begins to drip from the waste sample in less than 5 minutes, the sample fails and the test is terminated.

To gain accurate and dependable results, tests must be conducted at temperatures above the freezing point of all liquids in the sample. Tests may also be performed above room temperature, 25°C. Exposure to alkaline materials may cause the filter media to separate from the filter cone. However, if the sample is not disturbed, results remain accurate.

If the test is performed long in advance of shipment off site, free liquids may percolate through the container because of the weight of the wipes on top, and this may result in free liquids at the bottom of the container. Because there must be no free liquids in the containers at the time they are sent off site, the generator would be in violation of the no free liquids condition if free liquids were found in the container ready to be shipped, even if those wipes had previously passed the no free liquid test.

Liquids Release Test

The Liquids Release Test is a laboratory method that determines whether or not liquids will be released from a waste sample when subjected to the overburden pressures of a landfill. The waste sample is placed between two stainless steel screens supported by two stainless steel grids on opposite sides. The grids are followed by absorptive filter paper while a piston presses down on the top screen with a force of 50 pounds per square inch. Any release of liquid to the filter paper underneath the bottom supporting grid or above the top supporting grid indicates potential release if the waste were subjected to landfill conditions.

Although this test simulates landfill conditions, there are several sources of error. Effects of liquids from external sources, such as rain and snow, have not been estimated and, therefore, are not considered. Also, because some waste samples contain volatile solvents that may quickly evaporate after migrating to the filter paper, samples must quickly be examined as soon as tests are completed. In a limited study, EPA found that many disposable paper wipes pass this test even when considerable amounts of solvent are applied to samples. When solvent is applied at 50 percent of the wipe weight, most samples passed this test. When solvent is applied at 25 percent of the wipe weight, all samples passed this test. For solvents applied at 100 percent of the wipe weight, 88 percent (15 out of 17) of samples passed this test (SAIC 1997). Experiments yielded varying results when they tested disposable cloth wipes due to the method of and materials used in cloth wipe construction.

One-Drop Test

The One-Drop Test was developed by the Massachusetts Department of Environmental Protection and is used by generators in Massachusetts to determine whether industrial wipes contaminated with waste oil are saturated and/or hazardous. To pass the one-drop test, the wipe must not release "one drop" of solvent when hand-wrung. Use of a mechanical wringing machine is also recommended to guarantee meeting this standard. If one drop occurs, the solvent-contaminated industrial wipes must be managed as a hazardous waste, in accordance with 310 CMR 30.000 until samples pass the One Drop Test. Air-drying of wipes to satisfy the one-drop test is prohibited.

Solvent Removal Techniques to Meet the "No Free Liquids" Condition

In the course of developing this proposed rule, EPA found numerous techniques and technologies that can be used to meet the "no free liquids" condition and the "dry" condition discussed in Section IV.F.4. The decision to apply these techniques and technologies depends on several site-specific factors, including

- The amount of solvent placed on wipes;
- The number of wipes used daily;
- The amount of capital investment available to purchase advanced technologies; and
- The need to comply with other environmental regulations, such as Clean Air Act (CAA) National Emissions Standards for Hazardous air Pollutants (NESHAPs), and Clean Water Act (CWA) effluent guidelines.

The following sections describe physical and mechanical wringing methods and other non-thermal treatment technologies that are currently used, or can be used, to remove solvents from industrial wipes. These sections also provide some discussion on the applicability and efficiency of these treatment methods. Table 10 summarizes the experiments conducted with these technologies, as well as with combinations of these technologies.

Table 10
Summary of Experiments with Solvent-Removal Technologies
(Solvent Weight Two Times Dry Weight of Wipe)

Technology	Percent Solvent Removal
Screen-bottom drum	4-28
Mechanical wringing	12.9-55.8
Hand wringing	4.6-68
Mechanical wringing + hand wringing	9.8-43.8
Hand wringing + mechanical wringing	5.8-42.3
Mechanical wringing + screen bottom	10.8- 51.5
Hand wringing + screen bottom drum	8.8-52.7
Centrifuging	76-99

Source: SAIC, Use and Management Practices of Solvent-Contaminated Industrial Shop Towels and Wipes, December 23, 1997

Hand Wringing

Hand wringing can be used to remove any free liquids or contaminating solvents from reusable wipes and disposable paper and cloth wipes. Wipes are twisted by hand until no solvent appears. To test removal efficiency, the wipe can be weighed before and after twisting or wringing. Because of varying factors, such as the strength of the person wringing the wipe and the fabric type of the cloth wipe, solvent removal will not be as consistently effective as other techniques or technologies. Hand wringing can be very inexpensive unless large numbers of wipes must be hand-wrung, in which case labor costs must be considered.[14] This technique requires the use of personal protective equipment.

Based on the results of a 1997 study, mean removal efficiency ranged from 5 percent to 24 percent for reusable wipes and disposable paper wipes when the applied solvent was 2 times the weight of the wipe. For reusable wipes specifically, mean removal efficiency was 3.45 percent when the applied solvent was half the weight of the wipe and 11.3 percent when the applied solvent weighed twice as much as the wipe. Removal efficiency ranged from 1.6 percent to 68 percent for disposable cloth wipes when the applied solvent weighed twice as much as the wipe. Studies also show that mean removal efficiency is usually greater when more solvent is on the wipe (SAIC 1997).

Screen-Bottom Drums[15]

Screen-bottom drums can be used to remove free liquids from both reusable and

[14]Hand wringing may only be needed for wipes stored in the lower portion of the container if, because of percolation effects, the wipes in the higher portions of a drum do not contain much solvent.

[15] Descriptions of companies or technologies found in this Technical Background document are for descriptive purposes only and are not an endorsement of the products themselves.

disposable wipes. Screen-bottom drums are steel drums equipped with a screen or sieved-plate near the drum bottom. The screen or sieved-plate supports the contents of the drum, and is used to separate the industrial wipes from the liquids that have percolated to the bottom of the drum.

From site visits and experiments, EPA has found that wipes stored immediately above the screen tend to be saturated with large amounts of solvent as they can act as a dam and hold back solvent moving downward. Handlers must be careful to address this situation. This can be accomplished by hand-wringing the relatively small number of wipes sitting immediately above the screen or by transferring the wipes to another container with wipes already stored in it to start the percolation process again. This technology requires use of personal protective equipment for those handling the wipes.

Efficiency of screen-bottom drums appears to be dependent on the solvent being used and the type of wipe. Based on a 1997 study, mean removal efficiency ranged from 4 percent to 28 percent for all types of industrial wipes. A linear increase in wipe weight also exists as wipes from top to bottom are re-weighed after 24 hours of packing. Although this technology is not very efficient, it may be more useful if employed along with mechanical wringing or hand-wringing technologies.

Mechanical Wringing

Explosion-proof mechanical wringers can be used to remove any free liquids or contaminating solvents from reusable wipes and disposable paper and cloth wipes by using a mechanical device in a similar manner as the hand-wringing method. Mechanical wringers should have squeeze rollers made of materials that will not deteriorate when exposed to solvents. To test removal efficiency, wipes can be weighed before and after wringing. This technology requires use of personal protective equipment for persons handling wipes.

Removal efficiencies for mechanical wringing vary depending upon the type and makeup of disposable paper or reusable wipes. Based on the results of a 1997 study, mean removal efficiency ranged from 13 percent to 30 percent when solvent applied was twice the weight of the reusable wipes or disposable paper wipes. Removal efficiency ranged from 11 percent to 56 percent for disposable cloth wipes. Mean removal efficiency ranged from 7.5 percent to 19 percent when solvent applied was half the weight of the disposable paper wipe. Mechanical wringing removed as much as 30% of solvent from spent disposable paper wipes and reusable wipes and as much as 50% of solvent from some types of disposable cloth wipes (SAIC 1997).

Hand-operated mechanical wringers require a small capital investment and may, therefore, be most valuable for small quantity generators. EPA found these models priced from $600 to $2700.[16]

Centrifuging

[16]Prices referenced in this section reflect costs at the time EPA did research on these technologies in 1998-1999 and have not been updated to reflect 2003 costs.

Centrifuging is another solvent removal technology appropriate for disposable and reusable cloth wipes. Specially designed centrifuges remove solvent from wipes; over a hundred wipes are placed in a container and the centrifuge is operated for a few minutes, removing the solvent and leaving a dry wipe. Due to their complexity, centrifuges have a much higher capital cost and a generator can either purchase the unit directly or use a contract centrifuge service. Centrifuging machines should be explosion-proof. Also, this technology requires use of personal protective equipment for those handling the industrial wipes. Centrifuges are manufactured with a self-balancing, perforated basket allowing solvents to drain through the outer containment shell. It is estimated that a four-minute cycle can extract between 2.5 and 3.5 gallons of solvent for every load of 225 wipes processed.

EPA collected data on removal efficiencies of centrifuges, some of which is presented in *Use and Management Practices of Solvent-Contaminated Industrial Shop Towels and Wipes*, EPA, December 1997, found in the docket for the proposed rule.

One set of EPA tests led the Agency to estimate solvent removal efficiency to be about 50 percent. During these tests, the weight of the used wipe prior to centrifuging ranged from 2.3 to 3.9 times the weight of the unused wipe. Subsequent discussions with the company conducting the test found that the centrifuge was not operating properly and that removal efficiencies were regularly about 75 percent.

Other removal efficiency data supplied to EPA includes the following: (1) a centrifuge vendor, Maratek, indicates solvent removal efficiency of 85 percent (Newspaper Association of America TechNews, January 1997); (2) a Wisconsin printer indicates a removal efficiency of 76 percent. EPA also conducted controlled tests of a centrifuge operation with a Minnesota printer, John Roberts, and obtained solvent-removal efficiencies of 95 to 100 percent using a variety of disposable wipes and various solvents. Results of experiments conducted by Bock Engineering, a manufacturer of centrifuges, also found solvent-removal efficiencies in the 95 to 100 percent range.

The use of centrifuging is relatively uncommon. An industry survey of printing facilities indicated that about three percent use centrifuging (SGIA 1994b). This is consistent with observations made during EPA's site visits in 1997. Centrifuges can require a substantial capital investment. EPA found centrifuges processing 35, 60, 100, or 130 pounds per load to cost between $21,000 to $30,000. They are also available as a contracting service. Some services charge about $65/hour; about 1,500 to 1,800 wipes can be processed during this time. One contractor who uses a mobile centrifuging technology charges between 3 and 11 cents per wipe, depending upon the volume of wipes treated.

High-Volume Air Drying

The High-Volume Air Drying method uses laboratory hoods with high velocity air transport to achieve removal of contaminating solvents from disposable and reusable wipes. This technology, however, requires the use of expensive, carbon canister devices or other solvent vapor absorption devices and requires use of personal protective equipment for those handling

wipes.

High-volume air drying is extremely efficient, regardless of wipe type or solvent, resulting in nearly 100 percent efficiency with the use of a control device like a carbon canister to absorb solvent vapors. This technology is restricted, however, since inexpensive commercial devices needed for solvent vapor absorption are not readily available.

Microwave Technology

MicroChem, L.L.C. has developed a microwave technology similar in principle to household microwave ovens. With this system, solvent-contaminated industrial wipes are exposed to microwave power under a vacuum. The solvent is vaporized off of the wipes and captured as clean solvent which is returned to the generating facility for reuse. This process has a solvent recovery efficiency of 98 percent. Generating facilities using several hundred wipes per day can recover their investment costs by substituting recovered solvents for new solvent purchases. The cost of this system was unavailable but MicroChem is examining the feasibility of building mobile units.

Maratek Shop Towel On-Site Recycling System

The Shop Towel On-Site Recycling System is an integrated on-site dry cleaning/solvent recovery system designed primarily for organizations using at least 1,000 industrial wipes per day and large amounts of solvent on each wipe. At a cost of $177,000, this system can clean wipes and recover and reuse over 95 percent of the solvent contained on them. Again, cost savings are obtained by reusing solvent, thereby reducing purchasing costs for new solvents.

Industrial Laundry Solvent Recovery Systems

Brent Industries and Industrial Towel and Uniform, Inc. (ITU), among others, use petroleum-based solvents to process the industrial wipes, as well as to extract solvents contained on them for recovery and reuse. In both cases, any excess solvent recovered is either reused on site or sold to external customers.

Fierro Technologies

Fierro has developed a patented process in which totally enclosed vacuum extractors vaporize solvents out of woven and non-woven products to be recycled. Once the solvent is vaporized, the solvents are recondensed back into a liquid state for reuse by the generating facility. Solvent recovery rates are almost 100 percent, based on data generated by Fierro at the request of EPA.

IV.D.6. Exotic Solvents

Proposal

In the proposed rule, EPA requests information and comments on “exotic” solvents, such

as terpenes and citric acids, and how they are presently managed. Specifically, EPA asks for information and comments on the following to help the Agency develop a final rule.

- Which solvents that would currently be considered hazardous wastes are viewed as "exotic?"

- For which solvents do commenters believe a "no free liquids" condition would be problematic?

- Information on documented cases of combustion caused by a lack of free liquids.

- Comments on whether the final rule should give special consideration to wipes contaminated with exotic solvents, particularly allowing the solvents to be wetted down with water during accumulation and transport.

Discussion

In the process of developing this proposed rulemaking, the Agency learned that there are new, "exotic" solvents on the market, such as terpenes and citric acids, which, while labeled as non-hazardous, could actually be flammable.

Although the solvents do not exhibit the ignitability characteristic in 40 CFR 261.21, stakeholders have told us that, under certain conditions that have yet to be determined, oxygen can mix with the industrial wipes that contain these exotic solvents and spontaneously combust. According to some fire marshals and representatives of industrial laundries, resulting fires have caused major damage to facilities. Some stakeholders have suggested that EPA propose that generating facilities be allowed to transport their industrial wipes off site with free liquids if the facility is using one of these "exotic" solvents that could react or spontaneously combust, so that generators can wet down the wipes with water prior to sending them off site.

IV.D.7. *Proposed Condition for Generators who Remove Solvent from Industrial Wipes*

Proposal

Any solvent removed from an industrial wipe may be subject to regulation as a hazardous waste. Therefore, the generating facility would be required to determine whether the solvent removed from the industrial wipe, if it is not reused, is listed as a hazardous waste or exhibits a characteristic of hazardous waste and, if so, manage the solvent according to prescribed RCRA regulations under 40 CFR parts 260-268 and 270.

Under EPA's proposed exclusion from the definition of hazardous waste, the solvent-contaminated industrial wipes would not be hazardous waste at the time they undergo solvent removal. Therefore, solvent removal technologies would not be considered treatment of hazardous waste under RCRA and such operations, whether they are conducted by generators or handling facilities, would not be considered to be treating hazardous waste and would not require a RCRA permit.

Discussion

A number of facilities generating solvent-contaminated wipes that meet the definition of hazardous waste perform solvent extraction processes, such as hand wringing, mechanical wringing or centrifuging, all of which separate the spent solvent from used wipes. The resulting spent solvent is then sent to be recycled or disposed in compliance with RCRA subtitle C, if applicable.

EPA's proposed regulatory structure, which, if conditions are met, makes solvent-contaminated industrial wipes not hazardous waste at the time of solvent removal, thereby makes the solvent recovery process not treatment of hazardous waste. This structure is meant to encourage removal and recycling of solvents. Because the proposed rule does not impose RCRA requirements on solvent extraction, generators may be more likely to recover solvent for reuse and reduce the amount of solvent that they purchase. The provisional also makes the rule a more realistic option for smaller businesses which may be unwilling to undertake the RCRA permit process, but would like to be able to remove solvents from industrial wipes to meet the conditions of the proposed rule.

IV.D.8. *Proposed Conditions for Intra-Company Transfers*

Proposal

To encourage recovery and recycling of the solvents in the wipes, EPA is proposing to allow generators to continue to qualify for the exclusion from the definition of hazardous waste if they transfer solvent-contaminated industrial wipes containing "free liquids" between their own facilities and if the receiving facility has a solvent extraction and/or recovery process that will remove sufficient solvent to ensure the wipes meet either the "dry" condition or the "no free liquids" condition before being sent off site.

To be eligible for the exclusion, generators must meet the other conditions described in this notice. Specifically, the generator would be required to accumulate the wipes and solvents in non-leaking covered containers and to transport the industrial wipes in containers that are designed, constructed and managed to minimize loss to the environment and labeled "Excluded Solvent-Contaminated Wipes." EPA is proposing the same performance standard for intra-company transfers of wipes as for wipes meeting the "dry" and the "no free liquids" conditions. Note that because of the free liquids transported with these wipes, not all types of containers are likely to be appropriate (e.g., cloth bags are not likely to minimize loss for wipes containing free liquids). The solvent, once extracted, would have to be managed as a RCRA hazardous waste if going to disposal. EPA believes this option would result in substantial savings for generators of solvent-contaminated industrial wipes as well as in increased solvent recovery by generators.

Discussion

Several stakeholders, particularly those who use large numbers of wipes daily with large amounts of solvent on each wipe, would like to transfer their wipes to an intra-company facility that would extract the solvents from the wipes without meeting the "no free liquids" condition.

Several states already allow these kinds of transfers to be made when both the generating facility and the extracting facility are part of the same company. Under the proposed condition, the solvent extracted at this point could either be returned to the originating customer or sold to another manufacturer for reuse as a feedstock in a manufacturing or service operation. Alternatively, when the economics of solvent recycling are not favorable, the extracted solvents could be disposed as hazardous wastes.

The potential benefits to allowing such shipments under the conditional exclusion from the definition of hazardous waste include additional opportunities for increased recycling, because some generating facilities would find it more profitable to recycle solvents when not having to meet the "no free liquids" condition before sending industrial wipes to a facility with extracting capability. In this case, it is inefficient to remove the free liquids and then ship them to the centrifuge for more solvent extraction. As a result, many wipes go untreated. EPA hopes that, by taking advantage of the proposed provision, the companies in this situation would be able to reduce total solvent use through recovery and reuse, and, therefore, save money. As stated elsewhere in this proposal, several technologies already exist to extract and recover the spent solvent contained on industrial wipes both economically and safely. In addition, there are likely to be environmental benefits because solvent that would have been sent to combustion or disposal in a landfill would be recovered and reused.

A potential disadvantage of allowing intra-company transfers without assuring that the containers do not contain free liquids is that it increases the risk of a hazardous waste incident during transportation. Companies taking advantage of this would be required still to transport their wipes in DOT-approved, non-leaking containers and would not, as EPA sees it, be transporting the wipes very far. EPA is not proposing a specific distance that wipes can be transported under this provision, but is requesting comment on the issue.

Other Options

The specifics of other options for this provision aer laid out in the preamble for this rule.

IV.D.9. *Proposed Conditions for Management at Handling Facilities*

Proposal

Of all the handlers, generators have the primary responsibility for assuring that the industrial wipes they transport off site meet the conditions for the exclusion, but non-landfill facilities that receive disposable industrial wipes, such as combustors or handling facilities that perform further solvent removal, would also need to meet certain minimum conditions for the wipes to remain excluded from the definition of hazardous waste. First, during the time between when the wipes arrive and when the facility first introduces them into their process (e.g., when the wipes are removed from their container and placed in a solvent extractor), these facilities must store solvent-contaminated industrial wipes either–

(a) In containers that are designed, constructed and managed to minimize loss to the environment (i.e., that would meet the transportation condition in the proposed rule); or

(b) In non-leaking covered containers that would meet the generator conditions in the proposed rule.

The second condition is that if facilities (other than those intra-company facilities where solvent is removed) receive solvent-contaminated industrial wipes with free liquids, in order to retain the exclusion from the definition of hazardous waste, they would have to–

(a) Recover and properly manage any liquid solvent that arrives at the facility under federal or state hazardous waste regulations, as applicable; or

(b) Return the container (with the wipes and liquid) to the generator as soon as reasonably practicable (e.g., with the next scheduled delivery). When returning the wipes and liquid to the generator, the facility would have to transport them in containers that meet the original shipment conditions, but would not need to use a hazardous waste manifest.

Discussion

The objective of this condition is to address situations where free liquids arrive with industrial wipes at a handling facility through no fault of the handling facility. Rather than subject these materials to RCRA hazardous waste requirements, EPA is proposing that these materials be allowed to be further processed to ensure that the conditions of the exclusion are met. We believe this can be done safely and we also believe that this will provide additional incentive for solvent recovery. At any time that hazardous solvents are spilled or leaked, we would consider this to be disposal and the handling facility managing the solvents would be responsible for cleaning up the spill.

EPA believes there is no reason for handlers to open containers with solvent-contaminated wipes before the wipes enter the handling process. By not opening these containers, the potential for fires, exposure to workers and the general public decreases considerably. If free liquids are found once the container is opened, EPA would provide flexibility in what the handler can do. Currently, the handler is managing a hazardous waste if containers holding free liquids arrive. Under the proposal, EPA would provide flexibility to handlers in that they have two options to avoid a hazardous waste classification. They can either remove the solvent from the container themselves, continue to send the wipes through their process, and manage the solvent as a hazardous waste, or they can send the container with all materials enclosed back to their customer for them to manage properly.

This proposed condition fosters compliance without creating unnecessary burdens on either the generator or handler. Whether the handler removes the free liquids or sends the container back to the generator, additional costs are incurred that should be passed back to the generator–hopefully fostering changes in their process so that free liquids no longer arrive at the handling facility.

IV.D.10. *Management of Industrial Wipes Containing Co-Contaminants*

Proposal

Solvent-contaminated industrial wipes that exhibit a characteristic of hazardous waste due to co-contaminants also are not eligible for the exclusion, unless the characteristic is ignitability. Specifically, EPA is proposing that industrial wipes that exhibit the characteristics of toxicity, corrosivity, or reactivity because of wastes with which they are co-contaminated are not eligible for the conditional exclusion. On the other hand, because the industrial wipes are already likely to be ignitable because of the nature of the solvents on them, and because this risk is managed by the conditions of the exclusion, wipes co-contaminated with ignitable waste would remain eligible for the exclusion if they meet the other conditions of the exclusion.

Discussion

The proposed rule is not intended to override EPA's mixture rule regarding contaminants on industrial wipes other than the solvents specified in this proposal. In addition to these solvents, spent wipes from industrial applications may be contaminated with material removed during the industrial process–anything from dirt and grease to listed hazardous wastes. The presence of these co-contaminants may make the industrial wipes subject to the hazardous waste mixture rule (40 CFR part 261.3(a)(2)(iv)), which states that a mixture made up of any amount of a nonhazardous solid waste and any amount of a listed hazardous waste is a listed hazardous waste. Therefore, if the wipe contains a listed waste other than the identified solvents, it will be considered a listed hazardous waste and will no longer be eligible for the exclusion from the definition of hazardous waste being proposed.

Spent wipes from industrial applications are not only contaminated with solvents (some listed and/or characteristically hazardous), but they are also often contaminated with material removed during the industrial process. This material may be specific to the industry or process (e.g., inks and printing sludges; lacquers and other coatings from auto body repair; stains, shellacs and other coatings from the furniture production and refinishing industry), or they may be generic in nature (e.g., dirt, metal shavings, waxes and spent lubricating oils). In either case, these co-contaminants may pose a hazard to human health or the environment if they are disposed with spent wipes in a non-hazardous waste landfill or incinerator.

Previous investigations have identified the following industries as likely to produce significant quantities of spent wipes contaminated with listed or characteristically hazardous solvents:

- printing
- auto body repair
- furniture refinishing

The materials used in each of these industries and the tasks for which solvents and wipes are used suggest contaminants that are likely to be found on spent wipes. These contaminants are discussed below, in categories by industry. The information presented here is based on information gathered during site visits, literature research, and Internet searches.

Printing

The printing industry encompasses diverse processes for transferring images to a wide range of substrates, including coated and uncoated paper, polymer films, and fabrics. These diverse processes include lithographic, flexographic, offset, rotogravure and screen printing. All of these industrial printing processes generate waste ink and ink sludges that are frequently co-disposed with spent wipes. While actual ink formulations differ from process to process, they are generally composed of–

- A colorant (either pigment [insoluble colorant] or dye [soluble colorant]);
- A vehicle (which disperses the colorant); and
- A modifier (added to control ink or coating viscosity, slickness of the surface, drying time, stability to exposure to light and humidity, and rub resistance).

Colorants represent the most chemical diversity in the ink system, and pose the greatest potential for hazard. Colorants may be generally classified as–

- Organic pigments - based primarily on carbon but may contain metallic elements necessary to make the compound insoluble. They include azo compounds, triphenylmethane salts, rhodamines, and phthalocyanines.
- Inorganic pigments - including salts and oxides of lead, chromium, cadmium, barium, titanium, and iron; calcium carbonate, aluminum silicates, magnesium carbonate, and alumina hydrate; aluminum powders for silver inks and bronze powders for gold inks.
- Carbon black pigments - very small particle size and structural complexity in relation to all of the other pigment types.
- Acidic dyes - these have limited applications and are rarely used.
- Basic dyes - primarily aniline compounds.
- Azo metal complexes (dyes) - azo dyes complexed with inorganic constituents, most commonly chromium.
- Disperse dyes - low molecular weight organic compounds that sublimate at relatively low temperatures.

Little specific information could be found on the vehicles (dispersants) used in ink formulations. Ink MSDSs obtained on the Internet usually claimed the information to be proprietary or did not include any information at all. Anecdotal information indicates that the vehicles are usually solvents (at least for liquid inks), and that these solvents primarily consist of toluene, acetone, varnish maker's and painter's naphtha, xylenes, and various aliphatic hydrocarbons. Inadequate data is available to assess the relative proportion of solvent burden on the contaminated wipe at the time of disposal that can be attributed to solvent in the waste ink or sludge versus the amount of solvent applied directly to the wipe.

Modifiers are added to ink systems to control process and wear characteristics. The majority of these additives fall into one of the following categories:

- Phenolic resins

- Acrylic resins
- Hydrocarbon (petroleum-based) resins
- Cellulose and modified cellulose resins.

MSDSs indicate that glycol ethers and vinyl chloride monomer are also added as modifiers (vinyl chloride is a known human carcinogen).

No data could be found on the volumes of inks or specific colorants sold or used in any given time period that would allow one to draw even preliminary conclusions about the amounts of any of these components that are disposed of during a given time period, nor to estimate possible risks to human health and the environment posed by specific disposal scenarios. However, observations made during site visits conducted earlier indicate that the total amounts of waste inks and ink sludges disposed on contaminated wipes may be significant. As demonstrated by MSDSs, many of the colorants used include toxic compounds or elements, some of which are toxicity characteristic constituents. Insufficient data is available to estimate the fate of contaminated wipes in the TCLP.

Auto Body Repair

Site visits indicate that industrial wipes are one of auto body repair shops' multiple waste streams. Outside of general housekeeping activities, wipes appear to be used with listed or characteristically hazardous solvents for surface preparation. Some applications are–

- Wax and grease removal;
- Dust and particulate removal, including metal shavings and epoxy, acrylic and urethane resins; and
- Removal of lacquers and coatings.

The colorants present in automotive paints appear to be the same as many of those used in ink formulations. No data could be found on the volumes of automotive body fillers, paints and finishes, or specific colorants that would lead to conclusions about the amounts of these materials co-disposed with spent wipes or to estimate possible risks to human health and the environment posed by specific disposal scenarios. However, observations made during site visits indicate that the total volume of co-contaminants on spent wipes generated in body shops is not significant. As demonstrated by MSDSs, many of the colorants used include toxic compounds or elements, some of which are toxicity characteristic constituents. Insufficient data is available to estimate the fate of contaminated wipes using the TCLP. Additionally, reactants used in epoxy and urethane resin formation and curing are known to be toxic. Whether any significant amount of unreacted material is present on spent wipes is not known.

Furniture Refinishing

Furniture finishing and refinishing processes involve the application of solvents, stains, and finishes (lacquers, shellacs, urethane coatings), which generate spent wipes that are co-contaminated with all of these materials. Through anecdote, EPA found that production of spent wipes in these processes is significant. Insufficient data was available to make conclusive judgements about these materials, as most of the formulations are considered proprietary. MSDSs

do indicate that the formulations are solvent-based (primarily acetone, methyl ethyl ketone, isopropyl alcohol, aliphatic hydrocarbons and aromatic hydrocarbons), and that some finishes also may contain nitrocellulose. No information was located on the types of colorants used in wood stains. Insufficient information is available to estimate either the volume or composition of the waste stream, or to evaluate any potential hazard posed by co-disposal with spent wipes.

IV.D.11. *Proposed Conditions for Burning Solvent-Contaminated Industrial Wipes in Combustors*

Proposal

EPA is proposing that municipal and other waste combustors be allowed to burn solvent-contaminated industrial wipes that meet the proposed conditions for the exclusion. Facilities managing these wipes would have to ensure that the wipes remain in containers that meet either the proposed generator or transportation condition until they enter the combustion process. Also, if a combustion facility finds industrial wipes with free liquid solvents when it initiates processing of the wipes, for industrial wipes to retain the exclusion, the facility would have the choice of removing the free liquids and managing them as a hazardous waste or closing the container and sending the wipes back to the originating generator. When returning the wipes and liquid to the generator, the combustor would have to transport them in containers that meet the original shipment conditions, but would not need to use a hazardous waste manifest.

Discussion

The proposed rule would allow solvent-contaminated wipes to be managed at MWCs regulated under subtitle D and applicable state-specific controls, provided neither the wipes themselves, nor the containers they are in, contain free liquids and that they are shipped to the MWC in closed containers that are appropriately labeled. Destruction rates for solvents are expected to be at least 99.99 percent in MWCs, when comparing the incoming waste concentration to the ash concentration.[17] These rates are expected because constituents would be destroyed and/or would volatilize to the exhaust air. Based on the Agency's analysis of the potential risks associated with this proposal, the Agency found that given the rate of destruction expected to occur in MWCs, ash from burning solvent-containing wipes is not likely to exceed these limits.

The advantages of this approach include–

- Greater regulatory relief for generators;
- Decreased costs for treatment and disposal;
- Emissions controls stringent enough to ensure protection against potential releases

[17] As used here, destruction compares the composition of the exiting ash to the composition of the incoming municipal solid waste. For comparison, hazardous waste combustors require 99.99 percent destruction, when comparing the composition of the exiting air to the composition of the incoming waste. Because the constituents of concern are largely volatile, larger quantities of the unreacted constituent are expected to be present in exhaust gas rather than in ash residue.

of solvent constituents; and
- Greater potential for residues to remain under subtitle D controls.

The disadvantages of this approach include–

- Potential confusion due to variation in state-specific requirements for the management of wastes at MWCs; and
- Some MWCs may refuse to ever accept exempted hazardous waste.

Municipal Waste Combustors

MWCs do not obtain RCRA permits, do not operate under subtitle C management requirements, and therefore are prohibited from managing hazardous wastes, per 40 CFR 270.1(b). As proposed, however, solvent-contaminated wipes meeting the conditions of a regulatory exclusion would be excluded from the definition of hazardous waste. MWCs burning such wipes would be managing a "solid waste" rather than a "hazardous waste" and consequently would not be required to obtain a RCRA hazardous waste permit or meet the operating requirements or performance standards applicable to hazardous waste combustors (HWCs). MWCs are already subject to stringent performance standards that may be considered comparable to those applicable to HWCs regulated under 40 CFR part 264, subpart O. Thus, MWCs are capable of burning excluded wipes in a manner that is protective of human health and the environment.

Although the requirements for MWCs are generally promulgated at the state level, there are basic guidelines for thermal processing of solid wastes established at the federal level under 40 CFR part 240. These requirements delineate the minimum levels of performance required of any thermal processing operation. However, the addition of any further controls beyond the emissions standards established under the Clean Air Act (CAA) would be done through an individual state's municipal solid waste program. The guidelines or recommendations provided in 40 CFR part 240 also include–

- Designation of wastes acceptable for burning at facilities;
- Assurance that the facility has been designed to handle such wastes;
- Exclusion of wastes from being handled at a combustion facility based on certain criteria (i.e., facility's capabilities, alternative methods available, chemical and biological characteristics of the waste);
- Recommendations for general design, site selection, water and air quality, control of vectors, aesthetics, management of residues, and safety measures; and
- General operating procedures which specify that the facility should be operated and maintained in a manner that assures the facility will meet the design requirements. Recommended procedures include providing adequate personnel training, determining alternate disposal and operating procedures for emergencies, and creating routine maintenance schedules.

EPA promulgated revised air emission requirements for MWCs under the New Source Performance Standards (NSPS) on December 19, 1995 (60 *FR* 65387). The standards and

guidelines establish emission levels for–

- MWC organics (dioxins and furans only);
- MWC metals (cadmium, lead, mercury);
- MWC acid gases (hydrogen chloride, sulfur dioxide, and nitrogen oxides);
- MWC fugitive ash emissions from both new and existing MWCs;[18] and
- Other parameters, such as particulate matter and opacity.

In addition, operating conditions are specified, including carbon monoxide levels, load restrictions, and flue gas temperature at the PM control device inlet. Numerous other requirements concerning "good combustion practices" apply as well for MWCs (see 40 CFR part 60, subpart Eb). These requirements include feed rate limits, continuous emissions monitoring, annual stack testing, and certification of facility operators.

EPA has promulgated revised air emission requirements under the New Source Performance Standards for large new MWCs (facilities managing more than 250 tons of waste per day) under subparts Ea and Eb of 40 CFR Part 60 and large existing MWCs under subpart Cb of Part 60. There are 167 large MWCs in the US and all of these facilities now meet these standards. Similarly, EPA has promulgated revised NSPS air emission requirements for smaller MWCs (facilities managing less than 250 tons of waste per day) under Subparts AAAA and BBBB of 40 CFR part 60. All 39 existing smaller units should be retrofitted to meet these new standards by 2005. As described in the TBD, these NSPS standards provide a level of protection comparable to hazardous waste incinerators and should be able to burn solvent-contaminated wipes without any difficulty.

Hazardous Waste Combustors

Hazardous waste managed prior to burning in a boiler or industrial furnace (BIF) or incinerator is subject to all applicable RCRA regulations, including–

- The hazardous waste manifest system;
- The use of hazardous waste transporters; and
- Storage in hazardous waste management units meeting the standards of part 264/265 (e.g., container standards of subpart I, tank standards of subpart J).

BIFs and incinerators are regulated as hazardous waste treatment, storage, and disposal facilities, so they also must comply with the additional general management requirements of 40 CFR part 264/265, as follows:

- Hazardous waste general facility standards (subpart B);
- Preparedness, prevention, and emergency response standards (subparts C and D);
- Groundwater monitoring requirements (subpart F);
- Closure and post-closure requirements (subpart G); and

[18] New MWCs are defined as those for which construction is commenced after September 20, 1994.

- Financial assurance requirements (subpart H).

HWCs also must obtain RCRA hazardous waste operating permits, a process which involves public participation procedures.

EPA has updated the air emission standards for hazardous waste combustors, which are co-promulgated under RCRA and the CAA. This rule (64 *FR* 52828, September 30, 1999) establishes stringent air emission regulations for hazardous waste incinerators, hazardous waste-burning cement kilns, and lightweight aggregate kilns. The standards include limits on emissions of chlorinated dioxins and furans, mercury, particulate matter, semivolatile and low volatile metals, hydrogen chloride and chlorine gas, carbon monoxide, hydrocarbons, and destruction and revomal efficiency, in lieu of standards for nondioxin/furan organic hazardous air pollutants.

Comparison of Air Emission Standards

Table 11 presents a side-by-side comparison of the key air emission standards for new MWCs and HWCs. Table 12 presents a side-by-side comparison of the key air emission standards for existing MWCs and HWCs.

Table 11

Comparison of Key Air Emission Standards for New Combustion Units

Parameter	**New Municipal Waste Combustors (MWCs)**	**New Hazardous Waste Combustors (HWCs)**
1. Carbon monoxide (CO)	50-150 ppmv, depending on unit type	100 ppmv
2. Particulates (PM)	24 mg/dscm (0.010 gr/dscf)	34 mg/dscm (0.015 gr/dscf)
3. Cadmium (Cd)	0.02 mg/dscm (8.7 gr/mil dscf)	24 µg/dscm
4. Lead (Pb)	0.20 mg/dscm (87 gr/mil dscf)	24 µg/dscm
5. Mercury (Hg)	0.08 mg/dscm (35 gr/mil dscf), or an 85% reduction	45 µg/dscm
6. Dioxins/Furans	13 ng/dscm (or 7 ng with less frequent testing) (measured as total mass dioxins/furans)	0.20 ng/dscm (TEQ)
7. Sulfur Dioxide (SO_2)	The higher of 80% reduction or 30 ppmv	N.A.
8. Hydrochloric Acid (HCl)	The higher of 95% reduction or 25 ppmv	21 ppmv (HCl/Cl_2)
9. Hydrocarbons (HC)	N.A.	10 ppmv
10. Low Volatile Metals (As, Be, Cr, Sb)	N.A.	97 µg/dscm
11. Nitrous Oxide (NOx)	150 ppmv (large plants (>225 Mg/day) only)	N.A.
12. Fugitive Dust Emissions (fly ash/bottom ash)	Visible emissions <5% of time	N.A.
13. Opacity	<10% (6-minute average)	N.A.

Table 12

Comparison of Key Air Emission Standards for Existing Combustion Units

Parameter	Existing MWCs	Existing HWCs
1. Carbon monoxide (CO)	50-250 ppmv, depending on unit type	100 ppmv
2. Particulates (PM)	27 mg/dscm (0.012 gr/dscf) for large plants; 70 mg/dscm (0.03 gr/dscf) for small plants	34 mg/dscm (0.015 gr/dscf)
3. Cadmium (Cd)	0.04 mg/dscm (18 gr/mil dscf) for large plants; 0.10 mg/dscm (44 gr/mil dscf) for small plants	240 µg/dscm
4. Lead (Pb)	0.49 mg/dscm (200 gr/mil dscf) for large plants; 1.6 mg/dscm (700 gr/mil dscf) for small plants	240 µg/dscm
5. Mercury (Hg)	0.08 mg/dscm (35 gr/mil dscf), or an 85% reduction	130 µg/dscm
6. Dioxins/Furans	60 ng/dscm (if ESP-based controls) (30 ng/dscm otherwise) for large plants; 125 ng/dscm for small plants	0.20 ng/dscm (TEQ)
7. Sulfur Dioxide (SO_2)	The higher of 75% reduction or 31 ppmv for large plants; 50% reduction or 80 ppmv for small plants	N.A.
8. Hydrochloric Acid (HCl)	The higher of 95% reduction or 31 ppmv for large plants; 50% reduction or 250 ppmv for small plants	77 ppmv (HCl/Cl_2)
9. Hydrocarbons (HC)	N.A.	10 ppmv
10. Low Volatile Metals (As, Be, Cr, Sb)	N.A.	97 µg/dscm
11. Nitrous Oxide (NOx)	200-250 ppmv (large units (>225 Mg/day) only)	N.A.
12. Fugitive Dust Emissions (fly ash/bottom ash)	Visible emissions <5% of time	N.A.
13. Opacity	<10% (6-minute average)	N.A.

A comparison of the applicable air emissions standards for municipal waste combustors and hazardous waste combustors shows that the standards applicable to municipal waste combustors are similar or somewhat more stringent than the standards that apply to hazardous waste combustors, with the exception of hydrocarbons. Therefore, an evaluation of the potential effectiveness of municipal waste combustors in treating solvent-contaminated wipes, based solely on the basis of the technology and the emissions standards (and without a thorough evaluation of handling practices) leads to a conclusion that these units are as effective in treating or destroying the wastes.

It should be noted that, regardless of whether a municipal combustion facility manages solvent-contaminated wipes, the ash generated by these facilities is a newly generated waste and is subject to the waste identification requirements of 40 CFR parts 261 and 262. Owners and operators of MWCs must determine whether or not the ash generated at their facilities exhibits one or more of the characteristics of hazardous waste. If the ash generated at a MWC exhibits the toxicity characteristic, the ash must be managed as a hazardous waste in compliance with all applicable subtitle C management requirements, including the land disposal restrictions requirements.

Land Disposal Restriction Issues Related to Incineration of Wipes or Burning Wipes for Energy Recovery

EPA considered various options for modifying current RCRA rules to exclude industrial wipes contaminated with hazardous waste solvents from hazardous waste management regulations. This section discusses issues associated with the current applicability of the Land Disposal Restrictions (LDRs) at 40 CFR part 268 to these materials and with the combustion of solvent-contaminated wipes in MWCs.

Under the current RCRA regulations, hazardous wastes destined for land disposal must meet the LDR treatment standards. It can be reasonably assumed that thermal treatment technologies would be selected only for the treatment of nonwastewater forms of F001-F005. The nonwastewater LDR treatment standards for all organic solvent wastes are based on incineration.[19] However, any technology can be used so long as it meets the treatment standard. For organic wastes, the technologies selected typically involve combustion, such as incineration in a hazardous waste combustor or fuel substitution for energy recovery. For the purposes of the LDRs, combustion is defined at 40 CFR 268.42 as

> High temperature organic destruction technologies, such as combustion in incinerators, boilers, or industrial furnaces operated in accordance with the applicable requirements of 40 CFR part 264, subpart O, or 40 CFR part 265, subpart O, or 40 CFR part 266, subpart H, and in other units operated in accordance with applicable operating requirements; and certain non-combustive

[19]In fact, the Agency identified incineration as the basis for the LDR treatment standard for all organic constituents regulated in nonwastewaters with the exception of seven constituents: disulfoton, famphur, methyl parathion, parathion, phorate, diphenylamine, and diphenylnitrosamine (EPA 1994, 4-10).

technologies, such as the Catalytic Extraction Process.

Thus, combustion units receiving hazardous wastes must be permitted or have interim status under RCRA subtitle C to handle hazardous wastes. Municipal waste combustors, therefore, do not meet the LDR requirements for combustion.

IV.D.12 *Disposal of Treatment Residues from Municipal Waste and Other Combustion Facilities*

Proposal and Discussion

Under the proposed rule, when solvent-contaminated industrial wipes meet the conditions of the exclusion before being combusted, they would not be considered hazardous wastes. Therefore, the derived-from rule does not apply to the ash derived from the burning of these materials. In other words, as stated above, the ash generated by a MWC or other combustion facility is a newly-generated waste and is subject to the waste identification requirements of 40 CFR parts 261 and 262. Owners and operators of MWCs and other combustion facilities must determine whether or not the ash generated at their facilities exhibits one or more of the characteristics of hazardous waste. They may do so by using knowledge of the wastes they receive and/or generate, coupled with a knowledge of the capability of their combustor facility, or by testing the ash. If they determine that MWC ash exhibits a hazardous characteristic, the ash must be managed as a hazardous waste in compliance with all applicable subtitle C management requirements, including the LDRs.

IV.E. *Proposed Conditions for Exclusion from the Definition of Solid Waste for Reusable Solvent-Contaminated Industrial Wipes*

This section details a number of proposed conditions designed to ensure that reusable solvent-contaminated industrial wipes are handled as valuable commodities.

IV.E.1. *Proposed Conditions for Initial Storage and Accumulation*

Proposal

The proposed conditional exclusion from the definition of solid waste would apply to solvent-contaminated industrial wipes at the point where the generator ceases using them. If the wipes are managed according to the proposed conditions, they are not considered solid waste.

For the exclusion from the definition of solid waste, EPA is proposing the same performance-based on-site management condition as for the exclusion of disposable industrial wipes from the definition of hazardous waste. For reusable industrial wipes, when wipes are discarded, the user must place them in a non-leaking, covered container. This condition is described more fully in Section IV.F.1. above.

Discussion

Management standards for accumulation of reusable industrial wipes differ from state to state due to varying state policies. However, some trade associations and industrial laundries already encourage their members and customers to use closed or sealed containers during storage and transportation of solvent-contaminated wipes.

EPA believes that the proposed condition ensures responsible management of the wipes in a manner that is commodity-like by preventing the loss of wipes, preventing the loss of solvent which could be recovered and reused, and protecting against risks from fires. The primary type of damage incident identified by EPA as a result of the mismanagement of solvent-contaminated wipes is fire-related damage due to the ignitability or flammability of these materials. The proposed condition also allows for a wide variety of containers to be acceptable for accumulation of reusable wipes.

Site visits conducted by EPA in 1997 provided evidence that both open and closed containers are used for the accumulation of solvent-contaminated wipes. The most common management practices involved the use of a wide variety of containers, ranging from approximately five gallons in size (e.g., safety cans) to 55-gallon drums. Some sites also used safety cans as satellite accumulation units from which the wipes were later transferred to a centralized accumulation unit. As with the exclusion, the performance-based requirement proposed by EPA provides flexibility by allowing generators to accumulate solvent-contaminated wipes in any of these containers, including spring-bottomed drums, which prevent air releases when not being used, but accommodate the needs of workers constantly needing to open the drum. Under the proposed rule, generators may take innovative approaches to meet the performance standard rather than being required to use a specific design. A performance standard also provides a degree of flexibility in terms of allowing different approaches that minimize the length of time required for workers to place a used wipe in a storage container. This requirement also is in keeping with the spirit and intentions of OSHA regulations. Generators who already meet OSHA container standards should meet the proposed requirement for the safe on-site storage of solvent-contaminated wipes.

IV.E.2. *Proposed Conditions for Containers Used for Transportation*

Proposal

For transportation of reusable industrial wipes, EPA is proposing that facilities which transport reusable solvent-contaminated industrial wipes off site to an industrial laundry, a dry cleaner, or a facility that removes solvents from industrial wipes prior to cleaning, must do so in containers that are designed, constructed and managed to minimize loss to the environment; this is the same condition we are proposing for disposable industrial wipes that are conditionally excluded from the definition of hazardous waste. We believe this condition reflects the manner in which a commodity would be transported because it minimizes the possibility that valuable material would be spilled, lost or damaged during transportation.

Discussion

This condition is more fully described above in Section IV.F.2. In addition, implementation questions, as well as other options being considered, are discussed in the preamble to this proposal.

IV.E.3. *Proposed Conditions for Transportation to Laundry, Dry Cleaner, or Handler*

Proposal

EPA is proposing that generators be required to remove all free liquids prior to sending solvent-contaminated reusable industrial wipes off site to be cleaned for reuse. This condition is the same as the condition for disposable industrial wipes being transported for disposal at a non-land disposal facility, such as a municipal solid waste combustor, which is discussed in IV.F.5 above. Note, however, that there is no labeling condition for reusable industrial wipes.

Discussion

This condition and background information on this condition are discussed in the preamble of this proposal.

IV.E.4. *"Exotic Solvents"*

Proposal

In the proposed rule, EPA requests information and comments on "exotic" solvents, such as terpenes and citric acids, and how they are presently managed. EPA asks for information and comments to help the Agency develop a final rule.

Discussion

For a more detailed discussion of exotic solvents, see Section IV.F.6 of this technical background document.

IV.E.5. *Proposed Conditions for Generators who Remove Solvent from Industrial Wipes*

Proposal

Any solvent removed from an industrial wipe by a generator when using solvents in conjunction with industrial wipes may be subject to regulation as a hazardous waste. Therefore, the generating facility must determine whether the solvent removed from the industrial wipe is listed as a hazardous waste or exhibits a characteristic of a hazardous waste as defined in 40 CFR part 261 and, if so, manage it according to prescribed RCRA regulations under 40 CFR parts 260-268 and 270.

Discussion

Under the proposed exclusion from the definition of solid waste, the solvent-contaminated wipes would not be a solid or a hazardous waste at the time they undergo solvent-removal. Therefore, solvent removal technologies would not be considered *treatment* under RCRA and such operations, whether they were conducted at generating or handling facilities, would not require a RCRA permit. Further discussion of this issue can be found above in Section IV.F.7.

IV.E.6. *Proposed Conditions for Intra-Company Transfers*

Proposal

EPA is proposing that generators can qualify for the exclusion from the definition of solid waste when transferring solvent-contaminated reusable industrial wipes containing "free liquids," provided the transfer is between facilities within the same company, and the receiving facility has a solvent extraction and/or recovery process that removes enough solvent from industrial wipes for them to meet the "no free liquid" condition. Generators must transport the industrial wipes in containers that are designed, constructed, and managed to minimize loss to the environment.

Discussion

A more detailed discussion of this provision, as well as other options EPA is considering, can be found above in Section IV.F.8. However, reusable industrial wipes being managed under the exclusion from the definition of solid waste would not have to meet the labeling condition that disposable industrial wipes must meet.

IV.E.7. *Proposed Conditions for Management at Handling Facilities*

Proposal

As described for disposable industrial wipes, generators would have the primary responsibility for assuring that their industrial wipes meet the conditions for the proposed exclusion. However, handling facilities which receive and process reusable industrial wipes, such as industrial laundries, would also need to meet certain minimum conditions for the wipes to remain excluded from the definition of solid waste.

The first condition EPA is proposing states that to maintain the exclusion from the definition of solid waste for reusable industrial wipes, between arriving on site and entering a facility's process the wipes would have to be stored either–

(a) In containers that are designed, constructed and managed to minimize loss to the environment that meet the proposed transportation condition, or

(b) In non-leaking covered containers that meet the proposed generator accumulation condition.

The process begins when the laundry begins to handle the wipes. For example, at many laundries, the wipes are sent through a counting machine first, before they are cleaned, to record how many

wipes the generator has sent to be cleaned. In this example, wipes would enter the handling process when they are counted.

From site visits, we expect that at the laundries, the solvent-contaminated industrial wipes will generally remain in the containers in which they were transported. In the case where a facility chooses to transfer the industrial wipes into another container before the wipes enter the handling process, we are proposing that the generator condition, placement in a non-leaking covered container, would be sufficient to maintain the exclusion from the definition of solid waste.

Handling facilities would also not be allowed to mismanage free liquids. For example, an industrial laundry may not introduce free liquids into their laundering process. Facilities that happen to receive solvent-contaminated industrial wipes in containers with free liquids (unless they are being transported intra-company) would be required to either–

(a) Return the container (with the wipes and liquid) to the user (generator) as soon as practicable, or

(b) Recover and properly manage any liquid solvent that arrives at the facility under applicable federal or state hazardous waste regulations.

When returning the wipes and liquids to the user, the laundry would have to transport them in the containers that meet the original shipment conditions, but would not be required to use a hazardous waste manifest.

Discussion

The discussion of this provision of the proposed rule is discussed in the preamble of the proposal.

V. Summary of Risk Screening Analysis

V.A. *Introduction*

This section describes the approach EPA took to evaluate the risks from disposing of solvent-contaminated industrial wipes and their residues in landfills. EPA's risk screening and assessment approach used a series of mathematical models to evaluate the potential risks from landfilling industrial wipes containing hazardous solvents as well as the ash and sludge residues from combustion and waste water treatment processes, respectively. this section is meant as an overview of the risk screening did in developing this proposal. The actual report from the risk analysis is available in the docket to the proposed rule.

V.B. *Assessing the Risks from the Landfilling Industrial Wipes Containing Hazardous Solvents*

EPA conducted an analysis to determine the constituent-specific risks from landfilling F-listed spent solvents that are contained on industrial wipes used for cleaning and degreasing operations. This analysis addressed the following questions: (1) which F-listed constituents present the most risk; and (2) using reasonable assumptions, do circumstances exist where industrial wipes containing F-listed solvents can be managed in landfills without posing unacceptable risk to human health and the environment? For this analysis EPA evaluated disposal in a municipal solid waste landfill.

The overall approach to answering these questions consisted of three separate analyses. First, EPA calculated a risk loading threshold for each constituent, which is the daily solvent loading to a municipal landfill that poses unacceptable risks to human health. Second, using the results from this effort, EPA then compared the risk loading threshold for each F-listed solvent to the total solvent loadings disposed of in a landfill on a daily basis to determine whether the quantity of F-listed solvent disposed would pose unacceptable health risks. For this analysis, the human health benchmarks were a hazard quotient (HQ) of 1 for a noncarginogen and a carcinogenic risk of 10^{-5}. Values above these numbers were deemed to pose an unacceptable risk to human health. In conducting these analyses, EPA generally used a deterministic approach (i.e., discreet values of input parameters were selected).

This section provides some of the background on how solvent from solvent-contaminated industrial wipes could pose a risk to human health and the environment. In broad terms, generators use industrial wipes in conjunction with hazardous solvents and become a hazardous waste once the wipes no longer can be used. Once the hazardous waste is disposed in a landfill, the solvent contaminants contained on the wipe may leach, enter the groundwater, and impact an offsite receptor drinking water well. A resident could be exposed to these solvent contaminants through drinking water and non-ingestion routes, such as dermal and inhalation exposure. This analysis calculates a unit risk coefficient per day for each solvent, as well as the maximum quantity of contaminant that can be present in the landfill.

V.B.1. *Constituents Evaluated*

As stated elsewhere in this document, there are an almost infinite number of combinations of solvent blends used by generating facilities for cleaning and degreasing operations. Some generators use blends consisting of three or four constituents; others use pure solvents. Also, many generators use very few wipes a day while many others use thousands. In effect, no two generators are the same in terms of their solvent use practices. Because of this situation, EPA adopted a simplified approach to estimate unit risks from disposing of F-listed solvents in a municipal landfill.

For this analysis (as well as for the analyses associated with ash from combustion facilities and sludges from wastewater treatment processes), EPA evaluated 34 F-listed solvents (consolidated to 30 because of overlapping characteristics associated with cresol and xylene solvents) because the RCRA mixture rule (40 CFR 261.3(b)) dictates that any solid waste mixed with RCRA hazardous waste (e.g., wipes mixed with hazardous solvents) is a hazardous waste, even if only very small amounts of solvent are contained in the wipe. These constituents were selected because they are expected to be present in mixtures of hazardous waste spent solvent (e.g., F001 to F005) and wipes. Even though RCRA regulates other hazardous solvents (such as P- and U-listed commercial chemical products), EPA did not consider them for this analysis because it had no information on the frequency of occurrences for when these solvents might be spilled during production processes, creating a waste comparable to an F-listed solvent-contaminated wipe. However, EPA believes these spills should occur very infrequently compared to F-listed solvents used in normal cleaning operations.

Toxicity benchmarks for these 30 solvents are included in Table 13. Health benchmarks include Reference Doses (RfDs, for noncarcinogenic effects) and Cancer Slope Factors (CSFs, for carcinogenic effects) for estimating risk from ingestion and dermal exposures; risks from inhalation were determined using Reference Concentrations (RfCs, for noncarcinogenic effects) and inhalation unit risk factors (URFs, for carcinogenic effects). Benchmarks were principally obtained from EPA's Integrated Risk Information System (IRIS), supplemented with other sources as appropriate (see Table 13). Most of the compounds had oral benchmarks while a significant number did not have inhalation benchmarks.

Table 13
Constituents Present in F001 to F005 Solvents

Constituent	Solvent Listing	Oral Benchmark	Inhalation Benchmark
Noncarcinogens			
Nitrobenzene	F004	RfD: 0.0005	RfC: 0.002 [f]
Pyridine	F005	RfD: 0.001	RfC: 0.007 [f]
Ethyl ether	F003	RfD: 0.2	—
Acetone	F003	RfD: 0.1	RfC: 31 [f]
Methanol	F003	RfD: 0.5	RfC: 13 [f]
Butanol	F003	RfD: 0.1	—
Carbon disulfide	F005	RfD: 0.1	RfC: 0.7
Methyl ethyl ketone	F005	RfD: 0.6	RfC: 1.0
Methyl isobutyl ketone	F003	RfD: 0.08 [f]	RfC: 0.08 [f]
Cyclohexanone	F003	RfD: 5.0	—
2-Ethoxyethanol	F005	RfD: 0.4	RfC: 0.2
Tetrachloroethylene [d]	F002	RfD: 0.01	RfC: 0.3 [f]
Isobutyl alcohol	F005	RfD: 0.3	—
Cresols [a]	F004	RfD: 0.05 (o-, m-) RfD: 0.005 (p-) [f]	—
Chlorobenzene	F002	RfD: 0.02	RfC: 0.02 [f]
Ethyl acetate	F003	RfD: 0.9	—
Trichlorofluoromethane [d]	F002	RfD: 0.3	RfC: 0.7 [f]
Dichlorodifluoromethane [b]	F001	RfD: 0.2	RfC: 0.2 [f]
1,2-Dichlorobenzene	F002	RfD: 0.09	RfC: 0.2 [f]
Ethyl benzene	F003	RfD: 0.1	RfC: 1.0
Toluene	F005	RfD: 0.2	RfC: 0.4
1,1,2-Trichlorotrifluoroethane [d]	F002	RfD: 3.0	RfC: 30 [f]
1,1,1-Trichloroethane [d]	F002	RfD: 0.2 [f]	RfC: 1.0 [f]

Table 13
Constituents Present in F001 to F005 Solvents

Constituent	Solvent Listing	Oral Benchmark	Inhalation Benchmark
Xylenes (total) [c]	F003	RfD: 2.0 (o-, m-, and total) [f]	— (o-, m-) RfC: 0.43 (total) [F]
Carcinogens			
Methylene chloride [d]	F002	RfD: 0.06 CSF: 0.0075	RfC: 3.0 [f] URF: 4.7×10^{-7}
1,1,2-Trichloroethane	F002	RfD: 0.004 CSF: 0.057	URF: 1.6×10^{-5}
Carbon tetrachloride	F001	RfD: 0.0007 CSF: 0.13	URF: 1.5×10^{-5} [f]
2-Nitropropane	F005	—	RfC: 0.02 URF: 2.7×10^{-3} [F]
Benzene [e]	F005	CSF: 0.029 [e]	URF: 8.3×10^{-6} [e, f]
Trichloroethylene [d]	F002	CSF: 0.011 [f, g]	URF: 1.7×10^{-6} [f]

Sources of toxicity data are the Integrated Risk Information System (IRIS), except otherwise noted.
RfD (oral) is in units of mg/kg/d. RfC (inhalation) is in units of mg/m^3. Lower values correspond to more severely acute toxicity properties.
CSF (oral) is in units of $(mg/kg/d)^{-1}$. URF (inhalation) is in units of $(\mu g/m^3)^{-1}$. Higher values correspond to more severe carcinogenic properties.
a. The isomers o-, m-, and p- cresols were evaluated; risks from 'total cresols' were not evaluated. The highest risks were from p-cresol which were used to represent all 'cresols.'
b. The F001 listing identifies 'chlorinated fluorocarbons.' Dichlorodifluoromethane was selected as one such compound. Other chlorofluorocarbons are explicitly identified in the F002 listing.
c. The isomers o- and m-xylene were evaluated along with total xylenes.
d. These compounds are listed in both F001 and F002 descriptions.
e. Toxicity data for benzene was updated in IRIS subsequent to the risk analysis. The new assessment shows slightly lower carcinogenic properties from inhalation (i.e., the new inhalation URF is 2.2 to 7.8×10^{-6} $(\mu g/m^3)^{-1}$ compared to the value of 8.3×10^{-6} used in the risk assessment). Carcinogenic properties from oral properties are approximately unchanged (i.e., the new oral CSF is 0.015 to 0.055 $(mg/kg/d)^{-1}$ compared to the value of 0.029 used in the risk assessment).
f. Indicates IRIS was not used as a source for toxicity data. See EPA (1999) for complete referencing of all benchmarks.
g. EPA has recently published a draft health risk assessment for trichloroethylene (EPA, Trichloroethylene Health Risk Assessment: Synthesis and Characterization (External Review Draft, August 2001, EPA/600/P-01/002A). This source presents a range of CSFs, of 0.02 to 0.4 $(mg/kg/d)^{-1}$. It also presents an RfD of 0.0003 mg/kg-day. The range of CSFs in the draft health risk assessment is higher than that used in the risk screening assessment for industrial wipes. Additionally the draft health risk assessment presents an RfD; EPA did not assess noncarcinogenic effects of trichloroethylene in its risk screening assessment for industrial wipes. These new toxicity data in the August 2001 draft health risk assessment would result in higher risks from this constituent. However, the August 2001 report is not final and is undergoing external review.

V.B.2. *Transport, Fate and Receptor Assumptions Used to Estimate Risk Loading Thresholds*

The risk loading threshold was derived using the following approach:

- Generators use industrial wipes in conjunction with a certain amount (1.3 kg/day) of hazardous solvents on each wipe to derive a waste once the wipes no longer can be used. This quantity (1.3 kg/day) represents the estimated amount that would be necessary for a generator to become a large quantity generator (LQG). However, this quantity is used only as a base to derive unit coefficients and does not reflect the more complex loading assumptions detailed later in this report and used in identifying constituents posing unacceptable risks.
- The waste is disposed in a landfill.
- The solvent contaminants contained on the wipe leach, enter the groundwater, and impact an offsite receptor drinking water well.
- A resident is exposed to these solvent contaminants through drinking water and non-ingestion routes.
- The risk for each solvent is calculated.
- The maximum quantity of contaminant that can be present in the landfill is calculated using a noncarcingenic Hazard Quotient (HQ) of 1 or a carcinogenic risk of 10^{-5}. This is the risk loading threshold.

V.B.2.a. What Type of Landfill Is Used for Disposal of the Waste?

The landfill was assumed to be an municipal solid waste landfill (MSWLF), with no liner or leachate collection system. This assumption is consistent with the approach used in the proposed rule to list certain inorganic chemical manufacturing wastes as hazardous (65 *FR* 55684, September 14, 2000), as well as other risk assessments for similar decisions regarding regulatory decisions for hazardous and industrial wastes. Even though regulations currently specify design criteria for MSWLFs (40 CFR 258.40), including liners and leachate collection, the assumption that the landfill is unlined and has no leachate collection system is made, in part, because older unlined landfills may continue to be operating.

Another important parameter for this assessment is the type of cover used. Many of the solvent components are volatile and can pose potential risks from air as well as leachate exposure pathways. For this analysis, EPA assumed that a daily cover of six inches is used, consistent with federal regulations (40 CFR 258.21). A final cover of 30 inches was also assumed (regulations specify several layers of final cover including 18 inches of earthen material with 6 inches of top soil). Finally, the waste was assumed to be added in layers no more than 2.5 feet deep. The landfill was assumed to be operational for 30 years.

The screening analysis considered four specific scenarios, each corresponding to a different landfill size and climatic condition assuming receipt of industrial wipes from a large quantity generator:

- Median landfill size, high-end climatic conditions, LQG

- Median landfill size, median climatic conditions, LQG
- Small landfill size, high-end climatic conditions, LQG
- Small landfill size, median climatic conditions, LQG

A high-end ('small') and central tendency ('median') landfill were assumed to be 8,100 m^2 and 60,700 m^2, respectively. These correspond to the 10^{th} percentile and 50^{th} percentile sizes determined from *EPA's 1988 National Survey of Solid Waste (Municipal) Landfill Facilities*. Larger facilities were not evaluated because a sensitivity analysis showed that larger areas were associated with less risk for both leachate and air releases. As discussed later in this section, the scenario resulting in the highest receptor risks was a small landfill in high-end climatic conditions; these results were used in calculating the risk loading thresholds. The quantity of solvent placed in the landfill was also varied, however this variation was not relevant for development of the risk loading thresholds.

Contaminant release corresponding to two climatic conditions were evaluated: those corresponding to Lincoln, Nebraska (central tendency) and Houston, Texas (high-end). The central tendency site was the same one identified in the proposed 1995 Hazardous Waste Identification Rule. The high-end site was selected to attempt to represent a case where releases to both the groundwater and air pathways would be increased. These were selected from a total of 29 meteorological regions identified during the EPA Superfund Soil Screening Level program.

The most important climatic parameters affecting releases to the air are windspeed and temperature, while the most important climatic parameter affecting releases to groundwater is infiltration rate. The infiltration rates associated with these conditions correspond to 25 cm/yr for the central tendency case and 40 cm/yr for the high-end case.

V.B.2.b. How Are The Contaminants Assumed to Be Released from the Waste?

The contaminants in the waste were assumed to be available for release and not irreversibly bound to the matrix. A uniform quantity of waste was assumed to be disposed every day for 350 days per year for the entire 30-year operational life of the landfill.

Once in the landfill, the contaminants were assumed to be released from the waste to both the air and the leachate. EPA used a series of partitioning equations to determine how much contaminant mass would be retained in the waste management unit and how much would be released into the environment. These equations are based upon a series of articles by Jury and others (see EPA 1999). EPA used the partitioning equations to estimate the mass of a contaminant that would be lost from the landfill due to volatilization into the air, contaminant leaching into the subsurface, and degradation. These losses were assumed to occur during the entire 30-year active life of the landfill and for a 40-year post-closure period.

EPA assumed that volatilization losses could occur prior to the landfill being covered with daily cover or daily waste addition, through the daily cover, and through the cap that is placed on the landfill (or individual cells) after closure. The landfill model sums each of these contributions in a dynamic fashion. Note, however, that advective transport was not considered, which is the release of contaminant as landfill gas (e.g., methane), and in general the post-closure losses were

assumed to be negligible following the capping of the landfill.

EPA assumed that leachate losses could occur during the pre- and post-closure periods. In addition, losses as a result of biodegredation and hydrolysis were incorporated as an overall first order degradation rate (e.g., degradation calculated from a "half-life"). Such loss rates were identified from the literature, where most data represent soil.

V.B.2.c. How Are the Contaminants Transported Through the Environment?

The results of the previously described partitioning were used as inputs to the subsequent groundwater and air transport models. The risk assessment evaluated transport by a groundwater pathway and an air pathway. Specifically, residents living near landfills managing these wastes may be exposed to contaminated groundwater or vapors. For all contaminants, the groundwater pathway was found to be dominant.

Groundwater Pathways

For groundwater transport, the highest nine-year average leachate concentration was used as input to the groundwater modeling. Contaminant-specific modeling was not performed. Instead, an overall Dilution-Attenuation Factor (DAF) was used to estimate the dilution between the landfill and the receptor well; such DAFs were similarly used in EPA's 1995 soil screening analysis (see EPA 1999). The contaminant was assumed to reach an off-site drinking water well which serves as an exposure point to a receptor.

In the soil screening analysis, EPA's Composite Model for Leachate Migration with Transformation Products (EPACMTP) was used in a Monte Carlo framework. In this framework, values for different parameters affecting fate and transport are randomly selected within the constraints of their range in thousands of iterations, resulting in a corresponding thousands of values for the calculated DAFs. The DAF corresponding to the 95^{th} percentile was selected for each landfill area size. The Monte Carlo analysis varied the receptor well location anywhere within the groundwater transport plume up to one mile from the source. As a result of this analysis, a constant DAF of 11 was used in the solvent-contaminated industrial wipes analyses with the median size landfill, and a constant DAF of 27 was used in analyses with the small size landfill. Additional analyses were presented in EPA (1999) assuming a very close receptor well (i.e., more conservative) and assuming a liner was present (i.e., less conservative), although results are not presented here or used for calculation of the risk loading thresholds.

Air Pathways

For air transport, the Industrial Source Complex Short Term Model (ISCST3) was used to model the dispersion of volatile compounds from the landfill to a receptor located 75 meters from the source. The contaminant was diluted by transport and removed prior to reaching the receptor by deposition. The receptor becomes exposed via inhalation of the contaminant.

Note that while biodegredation of the organic constituents was considered in the landfill, no degradation effects were considered in the media transport pathways.

V.B.2.d. What Receptors Were Considered?

Risks associated with the following exposure pathways were considered for each constituent:

- inhalation of vapors transported off site as vapors
- groundwater ingestion
- indirect exposure of groundwater including inhalation in the shower, bathroom, and whole house, as well as indirect dermal exposure of groundwater.

All of the pathways consider two receptors: adult farmer and child. Appropriate intake assumptions for each receptor were obtained from EPA's 1997 Exposure Factors Handbook (EPA, 1997a) and are described in detail in EPA (1999). In general, average values were used for most of the exposure parameters.

Inhalation risk factors are estimated for a child in Houston exposed for 12 hours to constituents disposed of by a LQG in a small landfill 75 meters from the child's home. Groundwater ingestion risk factors are estimated for a child in Houston ingesting groundwater from a well located downgradient of a small landfill containing constituents disposed of by a LQG (well distance is determined by national distribution). Indirect exposure factors are determined by adding the HQs for inhalation of the constituent in the shower, bathroom, and whole house. These HQs are calculated using a unit concentration for the constituent's concentration in groundwater. The HQ calculations for dermal exposure were also based on the constituent's concentration in groundwater.

Separate risks were calculated for each of the four landfill management scenarios discussed above. For each scenario, risks were determined for the direct inhalation of the landfill vapors, ingestion of contaminated drinking water, and indirect exposure from household use of water. Both adult and child receptors were considered in the risk screening.

EPA evaluated carcinogens at a risk loading threshold of 10^{-5}, the same level used in the proposed rule to list chlorinated aliphatics wastes as hazardous wastes. In that proposal, EPA considered a decision to list wastes if the carcinogenic risks are 10^{-5} or higher (64 *FR* 46489, August 25 1999).

For each constituent, the exposure resulting from all sources of groundwater (i.e., ingestion, inhalation, and dermal exposures) were summed. Additionally, risks resulting from carcinogen exposure were summed (i.e., this affected each of the six contaminants with carcinogenic effects identified in Table 13).

Carcinogens are assumed to have cumulative effects, such that exposure to multiple carcinogens would present a greater risk than risks to a single constituent. In this analysis, such effects were accounted for by first calculating the risks posed by individual constituents. The cumulative risks were calculated by also adding the risks from all other lower toxicity carcinogens. The risk loading thresholds were subsequently calculated from these cumulative risks. This impact is shown in Table 14 for the six carcinogens. The additional toxicity is

calculated by dividing the sum of carcinogenic risks from all other carcinogenic contaminants by the risk from the individual contaminant.

For noncarcinogens, the contaminants are assumed to have independent effects (i.e., if a receptor is exposed to both methanol and acetone, the compounds are assumed to affect different parts of the body). Therefore, risks from different noncarcinogens are not 'summed.'

Table 14
Carcinogenic Effects of Solvent Constituents

For the following contaminant with carcinogenic effects...	The additional toxicity due to additive effects is...
2-Nitropropane	1x (Additional toxicity is negligible due to high toxicity of this contaminant.)
Methylene chloride	1.9 x
Benzene	2.6 x
1,1,2-Trichloroethane	1.5 x
Carbon tetrachloride	1.1 x
Trichloroethylene	1x (No additional effect because this contaminant is the least toxic)

V.B.2.e. What Are the Results?

The calculated risk loading thresholds are presented in Table 15. This table presents, for each F-listed constituent, the risks from various pathways assuming a loading of 1.3 kg/day per landfill. The sum of risks from these pathways are determined in the next to last column. The last column presents the calculated risk loading threshold, in kg/day. This amount is intended to signify the quantity of contaminant that can be placed in a landfill to result in an HQ of 1 or a carcinogenic risk of 10^{-5}. It is calculated by proportion. For example, in the case of acetone, a risk of HQ=0.75 results from a landfill loading of 1.3 kg/day. Therefore, by simple proportion, an HQ=1 is expected to result from a landfill loading of 1.7 kg/day. This assumes linear performance of all models; the uncertainty and limitation of this assumption are discussed in section V.B.6.

Groundwater receptor well concentrations were calculated for each of the four different combinations of climatic conditions and landfill size. The highest concentrations were selected for use in subsequent calculations; the highest concentrations resulted from the small landfill in a high-end climate (Houston, TX), although there was very little difference in the results from the two locations.

Risks from groundwater exposure were determined by adding risks from ingesting the water, from various inhalation pathways, and from dermal exposure. Each of these routes of

exposure was summed to identify the total risk from a particular contaminant resulting from all pathways.

The results of the last two columns illustrate which F-listed solvents could pose a problem if disposed in a landfill. For example, the risk loading threshold derived for nitrobenzene using the above assumptions is only 0.043 kg/day. Therefore, even very little nitrobenzene disposed in a landfill on a daily basis may pose a risk. Conversely, the risk loading threshold for ethy ether is 4.30 kg/day. Therefore, larger amounts of this solvent could be disposed without posing an unacceptable risk to human health.

The magnitude of these risk loading thresholds differ substantially, from 0.003 kg/day (for 2-nitropropane) to 403 kg/day (for 1,1,2-trichlorotrifluoroethane). Additionally, the dominant exposure pathway is different depending on the constituents, split between groundwater ingestion and indirect inhalation from groundwater use. This difference in risk loading thresholds is due to several factors, including the following:

- Differing toxicity between chemicals: as shown in Table 13, the carcinogenic URF for 2-nitropropane is very high, suggesting high toxicity. Both the noncarcinogenic RfD and RfC for 1,1,2-trichlorofluoroethane are very high, suggesting low toxicity.

- Chemical properties: chemical properties such as degradation rates, Henry's Law constant, and solubility affect partitioning between leachate, air, and solid in the landfill waste and/or between air and water in the receptor's house.

- Differing toxicity between routes of exposure: as shown in Table 13, many compounds do not have inhalation exposure benchmarks, and therefore risks from inhalation pathways were not estimated for these constituents.

Table 15
Risk Loading Threshold Results

Constituent	Relative Risk (as HQ or carcinogenic risk), based on disposal of 1.3 kg contaminant/day in a landfill					Resulting Risk Loading Threshold (kg/d, per landfill)
	From Direct Inhalation	From Ground-Water Ingestion	From Indirect Ground-Water Exposure (Inhalation)	From Indirect Ground-Water Exposure (Dermal)	Sum of Risk from Pathways	
Noncarcinogens (Risk expressed as hazard quotient)						
Nitrobenzene (F004) (U169)	0.00013	5	25	0.195	30	0.043
Pyridine (F005) (D038) (U196)	0.0003	90	120	0.78	211	0.006
Ethyl ether (F003) (U117)	—	0.3	—	0.002	0.30	4.30
Acetone (F003) (U002)	0.000002	0.7	0.05	0.001	0.75	1.73
Methanol (F003) (U154)	0.000002	0.2	0.02	0.0002	0.22	5.90
Butanol (F003) (U031)	—	0.8	—	0.005	0.81	1.61
Carbon disulfide (F005) (P022)	0.00007	0.08	2	0.0035	2.1	0.62
Methyl ethyl ketone (F005) (D035) (U159)	0.00003	0.1	4	0.00072	4.1	0.32
Methyl isobutyl ketone (F003) (U161)	0.0002	0.6	42	0.007	43	0.03
Cyclohexanone (F003) (U057)	—	0.02	—	0.0001	0.020	64.55
2-Ethoxyethanol (F005) (U359)	0.000008	0.3	0.04	0.0005	0.34	3.82
Tetrachloroethylene (F002) (D039) (U210)	0.0001	0.02	0.2	0.003	0.22	5.83
Isobutyl alcohol (F005) (U140)	—	0.3	—	0.0015	0.30	4.31
Cresols [a] (F004) (D023 to D026) (U052)	—	3	—	0.16	3.2	0.41
Chlorobenzene (F002) (D021) (U037)	0.0004	0.02	3.6	0.003	3.6	0.36
Ethyl acetate (F003) (U112)	—	0.08	—	0.00042	0.080	16.17
Trichlorofluoromethane (F002) (U121)	0.00007	0.0009	0.08	0.00009	0.081	16.05
Dichlorodifluoromethane (F001) (U075)	0.0002	0.003	0.6	0.0002	0.60	2.16

Table 15
Risk Loading Threshold Results

Constituent	Relative Risk (as HQ or carcinogenic risk), based on disposal of 1.3 kg contaminant/day in a landfill					Resulting Risk Loading Threshold (kg/d, per landfill)
	From Direct Inhalation	From Ground-Water Ingestion	From Indirect Ground-Water Exposure (Inhalation)	From Indirect Ground-Water Exposure (Dermal)	Sum of Risk from Pathways	
1,2-Dichlorobenzene (F002) (U070)	0.000002	0.0008	0.1	0.0005	0.10	12.84
Ethyl benzene (F003)	0.000009	0.007	0.1	0.002	0.11	11.95
Toluene (F005) (U220)	0.00005	0.006	0.6	0.001	0.61	2.14
1,1,2-Trichlorotrifluoroethane (F002)	0.000002	0.00002	0.0032	0.000003	0.0032	403.37
1,1,1-Trichloroethane (F002)	0.00004	0.002	0.08	0.0002	0.082	15.81
Xylenes (total) [b] (F003) (U239)	0.00001	0.0002	0.21	0.00007	0.21	6.18
Carcinogens (Risk expressed as carcinogenic risk)						
Methylene chloride (F002) (U080)	$4x10^{-9}$	$1.5x10^{-5}$	$2.1x10^{-6}$	$2.7x10^{-7}$	$I=1.7x10^{-5}$ $C=3.3x10^{-5}$	0.39
1,1,2-Trichloroethane (F002) (U227)	3x10-8	$7x10^{-6}$	$4x10^{-6}$	4x10-7	$I=1.1x10^{-5}$ $C=1.6x10^{-5}$	0.83
Carbon tetrachloride (F001) (D019) (U211)	$9x10^{-8}$	$2.6x10^{-6}$	$8x10^{-7}$	$4x10^{-7}$	$I=3.8x10^{-6}$ $C=4.3x10^{-6}$	3.0
2-Nitropropane (F005) (U171)	$9x10^{-6}$	—	$4x10^{-3}$	—	$I=4x10^{-3}$ $C=4x10^{-3}$	0.003
Benzene [c] (F005) (D018) (U019)	$5x10^{-8}$	$1.3x10^{-5}$	$7x10^{-6}$	$1.1x10^{-6}$	$I=2.1x10^{-5}$ $C=5.4x10^{-5}$	0.24
Trichloroethylene (F002) (D040) (U228)	$7x10^{-9}$	$2.7x10^{-7}$	$1.5x10^{-7}$	$5x10^{-8}$	$I=4.7x10^{-7}$ $C=4.7x10^{-7}$	27.66

For 'Sum of Risk Pathways' for carcinogens, 'I' refers to risks from the individual compound, while 'C' refers to the sum of risks from all other carcinogenic compounds of less toxicity. The risk loading threshold is based on the higher, 'C' results.
Source of relative risk results: U.S. Environmental Protection Agency. Estimating the Risk from the Disposal of Solvent-Contaminated Shop Towels and Wipes in Municipal Landfills." March 1999. The risk loading thresholds were calculated from these results.
Relative risk shows HQ or carcinogenic risks resulting from disposal of 1.3 kg/day in a landfill, which was necessary to conduct a 'forward' calculation. Risk loading thresholds show disposal rate that results in an HQ=1 or carcinogenic risk = 10^{-5}. This was calculated by dividing 1.3 kg/day by the sum of risk from all pathways (which based on a 1.3 kg/day disposal rate), and multiplying by HQ=1 or carcinogenic risk = 10^{-5}.
Shading indicates the dominant exposure pathway.
a. The isomers o-, m-, and p- cresols were evaluated individually; risks from p-cresol were greatest and presented here.
b. The isomers o- and m-xylene, and total xylenes, were evaluated individually; risks from total xylenes were greatest and presented here.

c. Updated toxicity data for benzene on IRIS shows slightly lower carcinogenic properties from inhalation compared to those used here. Because indirect inhalation exposure is not a 'driver' in this analysis when using the older toxicity information, the toxicity reassessment should not have a significant effect on this analysis.

V.B.3. *Estimating Total Risks from All Sources Disposing Solvent-Contaminated Industrial Wipes in a Landfill*

V.B.3.a. What Data was Used to Estimate Risk?

The above analysis calculated the maximum quantity of F-listed solvent constituents that can be disposed each day in a landfill such that resulting risks to human health would equal an HQ of 1 or a carcinogenic risk of 10^{-5}. Using these risk loading thresholds, EPA compared the thresholds to the estimated quantity of each solvent expected to result from disposing industrial wipes. To conduct the analysis, EPA looked at the following seven categories of data.

Number of Disposable Industrial Wipes Used Annually by Small and Large Quantity Generators

The number of disposable industrial wipes used nationwide was estimated in 2001 to be 1.009 billion, consisting of 49.8 million printer wipes and 959.2 million non-printer wipes. These estimates were made using data supplied by a trade association (Association of the Nonwoven Fabrics Industry) for 1997. These were updated to 2001 based on the average annual economic growth using the 'Industrial Production Index' for each of 13 industries which use wipes.

Number of Days Landfill Operates; Number of Landfills Nationally; Concentration of Facilities Sending their Wipes to a Single Landfill

For this analysis, EPA also distinguished between printer wipes and non-printer wipes since the printing industry appears to use much larger amounts of wipes and larger amounts of solvent on each wipe compared to most other industries. Also, because certain parts of the country have more generators per landfill than other parts of the country, EPA introduced the variable "concentration of facilities sending their wipes to a single landfill" to account for this situation.

In the U.S., there were 2,514 landfills in 1997 ('The State of Garbage in America,' BioCycle, April 1998). This is an average of about 50 landfills per state. However, some areas of the country are expected to have fewer landfills. The five states with the fewest number of landfills (Connecticut, Rhode Island, Delaware, Vermont, and Maine) have a total of 24 landfills, or an average of about 5 landfills per state. This is about ten times less than the national average. This factor of ten is incorporated into the risk screening assessment as a high-end parameter. This parameter is intended to identify regional effects where a relatively large number of generators is using a relatively small number of landfills, resulting in a higher landfill loading rate of solvent-contaminated industrial wipes in certain localities.

EPA assumed the landfills operate 350 days per year.

Percentage of Disposable Industrial Wipes Containing F-Listed Solvents

The likelihood that a facility would use an F-listed solvent was estimated to be 35 percent.

This assumes that facilities use F-listed solvents 25 percent of the time and toxicity characteristic (TC) solvents 10 of the time. The basis for the 25 percent value is data from the Screenprinting and Graphic Imaging Association International (SGIA 1998a).[20] The 10 percent value is an assumption also based on information from the printing industry.[21]

Percentage of Wipes that Could Contain a Given F-listed Solvent

The likelihood that the F-listed solvent would contain the subject contaminant is highly uncertain because representative data are not available. Each constituent was assigned a value of 10 percent or 50 percent. This signifies that if a facility actually uses an F-listed solvent (which, as described above, is assumed to only occur at 35 percent of facilities anyway), then this is the probability that the subject contaminant would be present. These numbers were arbitrarily selected. The following approach was used in assigning a value of 10 percent or 50 percent to each constituent:

- Data characterizing solvent composition in three sectors (printing, furniture, autobody repair) were prepared as an addendum to SAIC, "Use and Management Practices of Solvent Contaminated Industrial Shop Towels," Final Report, 1997. A total of 15 different F-listed constituents were found in the solvents identified. Each of these constituents were assigned a value of 50 percent since their use in solvents is documented. These 15 constituents are acetone, butanol, o-cresol, isobutanol, methanol, methyl ethyl ketone, ethyl acetate, tetrachloroethylene, cyclohexanone, ethyl benzene, toluene, 1,1,1-trichloroethane, trichlorofluoromethane, xylenes, and methylene chloride.

- Three compounds considered to be less toxic were assigned a probability of 50 percent. It was assumed that facilities would use these less toxic components preferentially over more toxic components. These three compounds are 1,1,2-trichlorotrifluoroethane, m-xylene, and o-xylene. (Note that data for the xylene isomers are not presented in Table 15.)

- The remaining constituents were assigned a value of 10 percent.

Concentration of Each F-Listed Solvent

The percentage of contaminant likely to be present in a solvent also has high uncertainty and variability. A solvent can contain contaminant concentrations ranging from less than 1 percent

[20]Based on a survey of used wipe disposal practices for printers, 18 percent of facilities indicated that they used methyl ethyl ketone, 27 percent reported using acetone, 20 percent reported using xylene, and 20 percent reported using toluene. Based on this data (all of which represent F-listed solvents), EPA assumed that 25 percent of facilities use F-listed solvents.

[21] The basis for this has been information from the printing industry identifying that 10 percent of solvents identified in the industry were nonhazardous, 10 percent were listed, and 80 percent were characteristic. Characteristic wastes comprise TC and ignitable-only wastes; EPA assumed that a portion (10 percent) are TC.

to 100 percent. Data characterizing solvent composition in three sectors (printing, furniture, and autobody repair) were prepared as an addendum to SAIC, "Use and Management Practices of Solvent Contaminated Industrial Shop Towels," Final Report, 1997. A total of 15 different F-listed constituents were found in the solvents identified (these 15 constituents are identical to those identified above). For each constituent in each industry, a range was developed using the data in the SAIC (1997) report. For constituents with no data, an arbitrary range of 5 to 50 percent was used which corresponded, approximately, to the range for most constituents with composition data. The arbitrary percentage range is uncertain because the data are not representative of the evaluated industries. For this analysis an average (rather than a maximum) concentration was used. The average concentration was calculated as the arithmetic mean between the two extremes of the range. A 'floor' of ten percent was established for each constituent to be consistent with the F001 to F005 definition. For each of the 30 constituents, the concentrations ranged from 10 to 51 percent; the exact concentration used was constituent-dependent.

Amount of Solvent Contained on Each Wipe

This analysis assumed that dry wipe weight was 25 grams. However, the amount of solvent contained on each wipe is dependent on industry type. It was assumed that wipes from printer facilities contain 25 grams of solvent whereas wipes from non-printer facilities contain only 12.5 grams of solvent. Therefore, a solvent to wipe ratio of 1 for printers and 0.5 for non-printers was used.

This estimate was derived from data collected from EPA site visits. These amounts were calculated by first weighing and measuring the dry wipe, giving it to the worker to add solvent to it, and measuring the weight a second time. The data were used to calculate a ratio of solvent added to dry wipe weight; a high ratio indicates that a large amount of solvent is used as compared to the size and weight of the wipe. As expected, there is wide variability in the amount of solvent placed on all types of wipe. Some of the facilities visited apply relatively small amounts of solvent to each wipe (i.e., the solvent/wipe ratio ranges from 0.1 to 1). Other facilities used solvent in a ratio between 2 and 3, while one facility had a ratio of 7, representing a saturated wipe. Conclusions from this investigation were that (1) within a facility or industry, different tasks require different quantities of solvent; and (2) the ratios for facilities within the printing industry were generally higher than the ratios from other facilities, such as those in the auto body industry. The selected solvent quantities represent the middle of the distribution, as determined from the site visits.

Percentage of Wipes that will be Landfilled (Rather than Combusted)

The percentage of disposable industrial wipes that are actually managed in a landfill was assumed to be 78 percent. This is equal to the quantity of municipal solid waste landfilled (118 million tons in 1995) divided by the quantity of municipal solid waste discarded (152 million tons in 1995). The difference is the quantity combusted (EPA 1997b).

Finally, the results of these calculations were converted to a landfill basis, for use in conjunction with the risk loading thresholds. This conversion accounts for multiple generators using a single landfill.

V.B.3.b. Summary of Assumptions Used to Estimate Risk

Table 16 summarizes the assumptions used for this analysis. Note that with the exception of solvent concentration and percentage of wipes containing a specific solvent, all of the other assumptions discussed above are fixed regardless of the contaminant.

Table 16
Variable and Assumptions Used in Estimating Total Risks from Disposing of Solvent-Contaminated Industrial Wipes in a Landfill

Variable	*Assumptions*
Factors Affecting Contaminant Quantity	
Number of Disposable Industrial Wipes Used Annually	Estimated at 1.009 billion wipes using Census data and trade association data
Percentage of wipes containing F-listed solvents	Only 35 percent of facilities are assumed to use F-listed solvent. Other solvents are not evaluated (as discussed in section V.B.1).
Percentage of wipes that could contain a given F-listed solvent	Each constituent was assigned a probability of 10 or 50 percent of being present in a solvent, based on usage information from site visits, etc.
Concentration each F-listed solvent	Constituents were assumed to be present as a mixture, with concentration ranging from 10 to 51 percent based on site visits and Material Safety Data Sheets (MSDSs)
Amount of solvent contained on each wipe	Disposables from printers were assumed to have a solvent weight of 25 grams, whereas disposables from non-printers were assumed to have a solvent weight of 12.5 grams.
Factors Affecting the Landfill Universe	
Percentage of wipes that will be landfilled (as compared to combustion)	Only facilities using MSWLFs, rather than municipal waste combustors (MWCs), were considered here. Seventy-eight (78) percent of municipal solid waste (MSW) is landfilled, 22 percent combusted.
Number of days landfill operates	350 days, assumed
Number of landfills nationally	2,514 based on 1997 BioCycle survey data
Concentration of facilities sending their wipes to a single landfill	A factor of 10 was used, as a high-end parameter, to account for localized effects of a relatively large number of generators clustered near a relatively small number of landfills.

The overall calculation is summarized below:

1,009 million	*number of disposables used by LQGs and SQGs*
× 0.35	*fraction with F-listed constituents*
× 0.78	*fraction landfilling (rather than combusting) disposable industrial wipes*
× 0.1 or 0.5	*fraction using given constituent*
× 0.1 to 0.51	*fraction of constituent in solvent (based on arithmetic average concentration)*
× [(0.049 ×	*fraction of disposables used by printers*
25) +	*grams of solvent per wipe for a printer*
(0.951 ×	*fraction of disposables used by non-printers*
12.5)]	*grams of solvent per wipe for a non-printer*
× 10	*concentration of facilities to a single landfill, above the national average (high-end parameter)*
/ 350	*days per year that landfill operates*
/ 2,514	*number of landfills nationwide*
1.13 to 10.4	kg/day loading to landfill, depending on the contaminant

Based on the calculations, it is assumed that from 1.13 to 10.4 kg/day of a constituent is disposed at a single landfill (depending on the constituent).

What if Solvent Loading is Reduced by Centrifuging?

As part of this analysis, EPA also examined the potential risks assuming less solvent was present on the disposable wipe. This analysis assumes generators use an advanced solvent extraction technology, such as centrifuging, where greater than 90 percent of solvent is removed.

V.B.4 *Risks from Landfilling Disposables*

Results of the risks from landfilling disposables in landfills are presented in Table 17. This table presents the following information for each constituent:

- The risk loading threshold, derived in section V.B.2. As previously described, reasons for different limits include differences in toxicity and physical/chemical properties.

- The landfill loading, derived in section V.B.3. This quantity is dependent on the contaminant and varies from a low of 1.13 kg/day/landfill for a number of contaminants, to a high of 10.4 kg/day/landfill for methylene chloride. As previously described, reasons for different loading between constituents include differences in the frequency of use and its concentration.

- Landfill loading, assuming a centrifuge is present. For this analysis, the landfill loadings were multiplied by 10 percent, as described in section V.B.3.

- One of three conclusions based on a comparison between the risk loading threshold and the landfill loading:
    - If the risk loading threshold is greater than the landfill loading, then EPA concludes that the contaminant is unlikely to present a risk given the assumptions used in the risk assessment. The contaminant is identified as 'Acceptable.'
    - If the risk loading threshold is less than the landfill loading (even assuming a centrifuge is present), then EPA concludes that the contaminant is likely to present a risk given the assumptions used in the risk assessment. The contaminant is identified as 'Ineligible.'
    - If the risk loading threshold is between the landfill loadings for centrifuged and not centrifuged wipes, then EPA concludes that the contaminant is unlikely to present a risk as long as centrifuging is conducted prior to disposal. The contaminant is identified as 'Centrifuge Required.'

In summary, Table 17 shows that of the 30 constituents evaluated, 16 constituents are acceptable, 8 are acceptable only if centrifuged beforehand, and the remaining 6 are ineligible because the projected loading is higher than the risk loading threshold.
More specifically, the following constituents were found for the above three categories:

- Acceptable (16 constituents): carbon tetrachloride, cyclohexanone, 1,2-dichlorobenzene, dichlorodifluoromethane, 2-ethoxyethanol, ethyl acetate, ethyl benzene, ethyl ether, isobutyl alcohol, methanol, tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, trichlorofluoromethane, 1,1,2-trichlorotrifluoroethane, xylenes.
- Centrifuge required (8 constituents): acetone, benzene, butanol, carbon disulfide, chlorobenzene, cresols, toluene, 1,1,2-trichloroethane.
- Ineligible (6 constituents): nitrobenzene, pyridine, methylene chloride, methyl ethyl ketone, methyl isobutyl ketone, 2-nitropropane.

Table 17
Evaluation of Disposable Solvent-Contaminated Industrial Wipes for Landfilling

CAS No.	Constituent (RCRA Waste Codes)	Risk Loading Threshold[a] (kg/d, per landfill)	Loading (kg/day, per landfill)	Loading Assuming Centrifuging (kg/day, per landfill)	Conclusion
Noncarcinogens					
67-64-1	Acetone (F003)	1.73	4.72	0.47	Centrifuge required
71-36-3	Butanol (F003)	1.61	2.05	0.21	Centrifuge required
75-15-0	Carbon disulfide (F005)	0.62	1.13	0.11	Centrifuge required
108-90-7	Chlorobenzene (F002) (D021)	0.36	1.13	0.11	Centrifuge required
108-94-1	Cyclohexanone (F003)	64.55	2.05	0.21	Acceptable
1319-77-3	Cresols (F004) (D023) (D024) (D025) (D026)	0.41	1.13	0.11	Centrifuge required
75-71-8	Dichlorodifluoromethane (F001)	2.16	1.13	0.11	Acceptable
95-50-1	1,2-Dichlorobenzene (F002)	12.84	1.13	0.11	Acceptable
141-78-6	Ethyl acetate (F003)	16.17	2.46	0.25	Acceptable
100-41-4	Ethyl benzene (F003)	11.95	2.05	0.21	Acceptable
60-29-7	Ethyl ether (F003)	4.30	1.13	0.11	Acceptable
110-80-5	2-Ethoxyethanol (F005)	3.82	1.13	0.11	Acceptable
78-83-1	Isobutyl alcohol (F005)	4.31	2.05	0.21	Acceptable
67-56-1	Methanol (F003)	5.90	3.49	0.35	Acceptable
78-93-3	Methyl ethyl ketone (F005) (D035)	0.32	4.00	0.40	**Ineligible**
108-10-1	Methyl isobutyl ketone (F003)	0.03	1.13	0.11	**Ineligible**[b]
98-95-3	Nitrobenzene (F004)	0.043	1.13	0.11	**Ineligible**
110-86-1	Pyridine (F005) (D038)	0.006	1.13	0.11	**Ineligible**
127-18-4	Tetrachloroethylene (F002) (D039)	5.83	4.82	0.48	Acceptable
108-88-3	Toluene (F005)	2.14	5.54	0.55	Centrifuge required

Table 17
Evaluation of Disposable Solvent-Contaminated Industrial Wipes for Landfilling

CAS No.	Constituent (RCRA Waste Codes)	Risk Loading Threshold[a] (kg/d, per landfill)	Loading (kg/day, per landfill)	Loading Assuming Centrifuging (kg/day, per landfill)	Conclusion
71-55-6	1,1,1-Trichloroethane (F002)	15.81	9.86	0.99	Acceptable
76-13-1	1,1,2-Trichlorotrifluoroethane (F002)	403.37	5.65	0.56	Acceptable
75-69-4	Trichlorofluoromethane (F002)	16.05	3.80	0.38	Acceptable
1330-20-7	Xylenes (total) (F003)	6.18	2.05	0.21	Acceptable
Carcinogens					
71-43-2	Benzene (F005) (D018)	0.24	1.13	0.11	Centrifuge required
56-23-5	Carbon tetrachloride (F001) (D019)	3.02	1.13	0.11	Acceptable
75-09-2	Methylene chloride (F002)	0.39	10.42	1.04	**Ineligible**
79-46-9	2-Nitropropane (F005)	0.0033	1.13	0.11	**Ineligible**
79-01-6	Trichloroethylene (F002) (D040)	27.66	1.13	0.11	Acceptable
79-00-5	1,1,2-Trichloroethane (F002)	0.83	1.13	0.11	Centrifuge Required

[a] Loading threshold shows disposal rate that results in an HQ=1 or carcinogenic risk = 10^{-5}.
[b] Methyl isobutyl ketone is listed for its characteristic of ignitability and therefore, when it is mixed with solid waste, is no longer considered hazardous waste unless it continues to display its characteristic. Therefore, although this assessment lists MIK as Ineligible, a wipe containing it can be disposed of in a landfill if it meets the other requirements.

V.B.5. *What High-End Assumptions Are Related With this Analysis?*

Separate sets of assumptions associated are with the two parts of this analysis: the assumptions regarding the loading of contaminants to the landfill and the assumptions regarding the subsequent transport and exposure. High-end assumptions are summarized here. The next section, section V.B.6, identifies areas where the analysis is uncertain or may potentially underestimate risk.

The high-end assumptions identified in the analysis, as they relate to the loading of the contaminant to the landfill, include the following:

- Other than centrifuging, no other removal processes are assumed to occur prior to landfilling. This includes evaporation.[22] Removal efficiencies of such processes are variable.

- The number of generators using a single MSW landfill is assumed to be ten times greater than the national average. Such an approach assumes a 'localized concentration' of generators.

Additionally, once the contaminant enters the landfill a number of additional high-end assumptions are associated with fate and transport. These include the following:

- The contaminants in the waste are assumed to be available for release, not irreversibly bound to the matrix.

- Assumption of use of one of four scenarios which results in the greatest receptor well concentrations (i.e., in this case, a small landfill).

- The DAF for groundwater transport was evaluated at the 95th percentile level in a Monte Carlo analysis.

V.B.6. *What Uncertainties and Limitations Are Related With this Analysis?*

Uncertainty and limitations can be categorized according to (1) exposure and toxicological benchmarks, (2) the loading of the constituent to the landfill, and (3) the partitioning, transport, and exposure of the constituent once it enters the landfill. Many uncertainties, limitations, and comments regarding the predictive nature of the assessment were identified when the EPA (1999) report was distributed to three outside experts as a peer review.

V.B.6.a. Overall Uncertainty

EPA did not attempt to quantify total uncertainty of the analysis and thus does not know the direction or magnitude of each of the identified uncertainties. EPA did not conduct a field validation effort to identify the direction of the uncertainties. Thus, the cumulative impact of these uncertainties is unknown.

EPA did not conduct a sensitivity analysis that would identify the most sensitive parameters in the assessment. This adds some uncertainty into the modeling application because the databases and modeling methodology associated with these parameters could be reviewed for completeness and acceptability if the most sensitive parameters were identified. EPA recognizes that the "source term" assumptions associated with the landfill are likely to be uncertain because the data associated with developing these assumptions was generally limited.

[22] As part of their petition, Kimberly-Clark submitted data showing the evaporation rates of certain solvents from disposable industrial wipes. SAIC (1997) also presents data regarding evaporation rates under a variety of conditions.

V.B.6.b. Uncertainty in Benchmarks and Exposure Assumptions

Sources of uncertainty in toxicological benchmarks include one or more of the following: extrapolation from laboratory animal data to humans, variability of response within the human population, extrapolation of responses at high experimental doses under controlled conditions to low doses under highly variable environmental conditions, and adequacy of the database (number of studies available, toxic endpoints evaluated, exposure routes evaluated, sample sizes, length of study, etc.). Toxicological benchmarks are designed to be conservative (i.e., to overestimate risk) because of the uncertainties and challenges associated with condensing toxicity data into a single quantitative expression.

Another important area of uncertainty involves estimates of risks to children from carcinogenic compounds. EPA estimated the risk of developing cancer from the estimated lifetime average daily dose and the slope of the dose-response curve. A cancer slope factor is derived from either human or animal data and is taken as the upper bound on the slope of the dose-response curve in the low-dose region, expressed as a lifetime additional cancer risk per unit exposure. However, individuals exposed to carcinogens in the first few years of life may be at increased risk of developing cancer. EPA did not adjust the cancer slope factors to account for age-specific differences in exposure assumptions (e.g., body weight). However, EPA recognizes that significant uncertainties and unknowns exist regarding the estimation of lifetime cancer risks in children. Methodologies for estimating environmental threats to children's health are relatively new. They are currently being debated within the scientific community and will continue to evolve.

Non-cancer effects in children is also an area of uncertainty. Non-cancer reference doses and reference concentrations for children are based on comparing childhood exposure, for which EPA has age-specific data, with adult toxicity measures, where adequate age-specific dose-response data is lacking. This mismatch results in a large amount of uncertainty in the estimation of hazard quotients for children and would sometimes result in an overestimation of children’s risk and sometimes in an underestimation. This issue is still under investigation in the scientific community, and no consensus has been reached.

Another uncertainty is the impact of inter-individual variability in exposure. In this analysis, exposure variables (for example, media intake rates, residence duration) are fixed for all receptors of a given type and age. Preliminary simulations suggest that variability may not be too large given the large variability of media concentrations nationally. However, with further regionalization and refinement of environmental fate and source characterization model inputs, inter-individual variability in exposure could become a significant factor in model output in the future.

In addition, the analysis only considered exposure to groundwater through household uses of the water. Other potential exposures to groundwater could occur through the use of groundwater for crop irrigation and through use of surface waters fed by contaminated groundwater. EPA expects that these exposures would be significantly lower than the exposure through household use.

V.B.6.c. Uncertainty in Chemical Fate and Transport

Another important area of uncertainty is the transformation of chemicals that can occur either in the waste management unit or in environmental media. Once chemicals are placed in a waste management unit, this analysis assumed that various processes such as biodegradation and hydrolysis act to change the chemical. These changes result in transformation products. Often the transformation from one chemical to another results in a less toxic chemical; however, for a few chemicals, the resultant transformation products can be more toxic. The risk assessment did not model transformation products.

The risk screening assessment accounts for degradation within the landfill, although this is expected to differ on a case-by-case basis due to the following factors:

- Some landfills may be constructed to encourage or discourage degradation;
- The presence of a liner may slow the migration of a contaminant, in effect giving it more time to degrade within the landfill;
- While degradation in the groundwater flow path was not considered in the assessment, their varying rates of decomposition (i.e., 'half lives') indicate that some contaminants could be expected to degrade more quickly than others in the environment.

As a result of these effects, contaminants with relatively short half-lives are expected to be impacted by this uncertainty to a greater extent than contaminants that are not expected to degrade quickly. For contaminants that were not assumed to degrade or for which degradation was not assumed to occur due to lack of data (e.g., ethyl ether), this uncertainty cannot be assessed.

In modeling the fate and transport of chemicals in groundwater, EPA did not assess complex hydrogeology such as karst or highly fractured aquifers. Some fraction of the groundwater settings in this analysis have fractured flow. In general, fractured flow in groundwater can channel the contaminant plume, thus allowing it to move faster and more concentrated than in nonfractured flow environment. This would result in higher concentrations in the groundwater.

In addition, the modeling methodology itself is another source of uncertainty, because models and their mathematical expressions are simplifications of reality that are used to approximate real-world conditions and processes and their relationships. The sources of model uncertainty include relationship errors and modeling errors. Models do not include all parameters or equations necessary to express reality because of the inherent complexity of the natural environment and the lack of sufficient data to describe the natural environment. Consequently, models are based on numerous assumptions and simplifications and reflect an incomplete understanding of natural processes.

EPA selected the models used in this risk assessment based on science, policy, and professional judgment. These models were selected because they provide the information needed for this analysis and because EPA generally considers them to be state-of-the-art science. Even

though the models used in the risk analyses are used widely and have been accepted for numerous applications, they each retain significant sources of uncertainty. Evaluated as a whole, the sources of model uncertainty in our analysis could result in either an overestimation or underestimation of risk.

V.B.6.d. Uncertainty in Site Characteristics

EPA was not able to directly measure many of the site characteristics (for example, depth to groundwater; aquifer thickness; hydraulic conductivity; location of wells; behavioral characteristics of receptors) near each landfill to estimate risk. These model inputs were characterized through regional and national databases. As a result, the data used has several limitations. Overall, the use of regional and national input data rather than site-based facility and environmental data could cause estimated concentrations to be low or high at a given location, with no known general bias.

In addition, the risk assessment tracks individual chemicals from waste disposed in landfills into the surrounding multimedia environment at a series of locations around the country. A variety of transport processes, including volatilization, leaching, runoff, erosion, advection, dispersion, and deposition, move chemicals from the landfills through the multimedia environment to locations where human receptors are likely to be exposed. A set of chemical-specific data are required for the environmental simulation models that are used to calculate chemical fate and characterize the resulting exposures and risks.

Some of the chemical properties, such as solubility and effective hydrolysis rate constants, will vary with temperature and pH across different sites. The uncertainty resulting from the assumptions concerning environmental conditions results from a paucity of data describing conditions at waste management sites and from the requirement to conduct the assessment on a national basis.

V.B.6.e. Some Uncertainties and Limitations of the Landfill Loading Term

The most significant uncertainty in estimating landfill loading results from cumulative calculations. As shown in section V.B.3, the landfill loading is calculated from a series of assumptions, each of which is highly variable (e.g., the concentration of contaminants in the solvents). Other significant limitations include the following:

- Only compounds identified as the basis for listing F001 to F005 were considered in each analysis (e.g., co-contaminants such as metals and other compounds that could be present in solvents were not considered). Also, EPA did not consider other hazardous solvents due to the lack of data on their occurrence.

- The analysis only accounted for wipes generated by LQGs and small quantity generators (SQGs), but negligible amounts of the constituent are present in the rest of the solid waste sent to the landfill. Therefore, it does not account for the potential introduction of the constituent by conditionally exempt small quantity generators (CESQGs) and from household hazardous waste.

V.B.6.f. Linearity of Models

Most of the transport calculations are linear. For example, if landfill loading is doubled, then the groundwater concentration is also doubled. The risk loading thresholds presented in Table 15 assume such a linearity of the results. The indirect exposures, however, are not necessarily linear. This is because the indirect inhalation model is comprised of a series of modules and equations, with terms that rely on the differences in concentrations between different media. Risks for such indirect exposures were calculated assuming a uniform groundwater concentration of 1 mg/L for each constituent (EPA 1999). For simplicity, this risk screening assessment assumed that such results are linear (e.g., a groundwater concentration of 2 mg/L was assumed to result in twice the indirect exposure risk than a groundwater concentration of 1 mg/L).

This assumption is expected to be appropriate for calculated groundwater concentrations near 1 mg/L. However, as the receptor groundwater concentration becomes much less (or much greater) than 1 mg/L, there is expected to be greater uncertainty in the results. EPA did not evaluate the effect of this uncertainty on the results.

V.B.7. *What Are the Results of the Peer Review?*

In September 1998, the risk analysis was sent to three experts outside of EPA. The peer review was limited to the fate of the constituents once the waste enters the landfill. The comments are detailed separately (EPA, Summary and Assessment of Peer Review Comments Solvent-Contaminated Towels, Rags, and Wipes, November 18, 1998) and summarized below. The reviewers identified ways in which the analysis is conservative, ways in which the analysis underpredicts risk, and uncertainties in the approach.

Ways in which the analysis was found to potentially over-estimate risks include the following: (1) the model accounts for too little degradation of the solvent components in the landfill; (2) the assumption that none of the solvent is permanently bound to the wipe is conservative, as is the assumption that no degradation occurs after the compound leaves the landfill (unfortunately, insufficient data is available in the literature to adequately quantify these effects); and (3) trichloroethylene's carcinogenic health effects may be overestimated.

Ways in which the analysis may underestimate risks include the following: (1) additional parameters other than climatic/geographic conditions and landfill size could be relevant and should be considered in the sensitivity analysis (a finding that other parameters are more sensitive than those parameters set at a high-end would increase the modeled risk); (2) groundwater transport could result in larger risks than specified; (3) effects from co-solubilization and co-contaminants could increase risk; (4) the potential carcinogenic effects from one constituent, tetrachloroethylene, should have been considered; and (5) additional transport pathways exist and may result in higher risks than the pathways and risks evaluated. The latter includes evaluating a potentially more sensitive receptor (worker at a landfill) and advective transport from the landfill resulting from the generation of methane. In addition, in considering degradation, the report ignores any effects from toxic daughter products, which would increase the risk to a receptor.

Other factors include those which have unknown effects on the risk assessment results. These include (1) misapplication of the landfill partitioning equations; (2) a need for greater and better presentation of uncertainty; (3) the lack of comparisons to actual or observed conditions which could support the conclusions of the report.

EPA did not modify the risk analysis to address peer reviewers' concerns but plans, instead, to address the peer review comments in conjunction with addressing public comments from the proposed rule. This approach was pursued in order to address all comments at one time before finalizing the proposal.

V.B.8. *Recommendations*

EPA today is proposing the following based on the findings of its risk screening analyses coupled with several policy decisions that address the uncertainties of these analyses:

- With respect to industrial wipes containing F-listed solvents disposed directly in municipal landfills, EPA is proposing not to allow the following 11 F-listed solvents in municipal landfills either because they pose unacceptable risks and/or because those solvents are found in the Toxicity Characteristic (TC) List (See 40 CFR 261.24). These F-listed solvents are pyridine (TC), nitrobenzene (TC), cresols (TC), methyl ethyl ketone (TC), tetrachoroethylene (TC), chlorobenzene (TC), 2-nitropropane, methylene chloride, benzene (TC), carbon tetrachloride (TC), and trichloroethylene (TC). Of these 11 constituents ineligible for landfilling, 9 are toxicity characteristic (TC) solvents. Of these 9 TC solvents, six (6) were not found to pose an adverse risk in the analysis. However, EPA is proposing that they be ineligible for landfilling because of their status as TC wastes.

- With respect to the remaining 19 F-listed solvents, EPA is proposing to allow these solvents to be disposed of in municipal landfills provided they are "dry"; i.e., the wipes do not contain more than 5 grams per wipe solvent. This is in some cases more stringent than the results of our risk screening analysis. Because of the uncertainties and lack of detailed demographic data in the risk screening analysis, EPA has chosen to propose a more stringent condition in order to compensate for possible inaccuracies and to provide a simpler regulatory structure. However, the five gram standard for all contaminated wipes going to landfill should be achievable by many generators with little or no effort since they use very little solvent on each wipe as part of their production process. This proposed approach continues to provide regulatory relief and flexibility to generators, and has the benefit of providing a simple regulatory structure. In addition, the risk analysis shows the five gram standard to fall within the range of what is shown to be safe.

V.C. *Ecological Risks*

Because constituents in these industrial wipes may impact ecological receptors differently

than human health receptors, a screening level analysis was conducted to assess potential ecological risks.

First, EPA identified appropriate ecological benchmarks. EPA developed freshwater benchmarks in preparation of the proposed 1999 Hazardous Waste Identification Rule (64 *FR* 63381, November 19, 1999). EPA also identified freshwater benchmarks in support of developing a protocol for permitting RCRA hazardous waste combustion facilities (Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft November, 1999). As a result, aquatic benchmarks were identified in this manner for 10 of the 30 constituents which form the basis for listing F001 to F005 wastes. These aquatic toxicity benchmarks are identified in Table 18. For convenience, Table 18 also identifies the underlying sources of the data identified in these two reports.

EPA conducted additional analyses to account for dilution of groundwater infiltration to a surface water body, using a conservative approach. First EPA identified a typical flow rate and dimensions of a small stream (i.e., because higher contaminant concentrations would result from a small stream). Next, it identified the quantity of leachate generated from the modeled landfill and assumed that 100 percent of the contaminant leaving the landfill as leachate would enter the surface water.

Table 18
Aquatic Benchmarks for Constituents in Solvent-Contaminated Industrial Wipes

Constituent Name	Concentration, mg/L	Source
Acetone	1.5	(1); Suter and Tsao (1996)
Benzene	0.13	(2); Stephan et al. (1985); Suter and Tsao (1996)

Table 18
Aquatic Benchmarks for Constituents in Solvent-Contaminated Industrial Wipes

Constituent Name	Concentration, mg/L	Source
Carbon disulfide	0.00092	(2); Stephan et al. (1985); Suter and Tsao (1996)
Chlorobenzene	0.064	(2); Stephan et al. (1985); Suter and Tsao (1996)
Methylene chloride	2.2	(2); Stephan et al. (1985); Suter and Tsao (1996)
Nitrobenzene	0.27	(1); U.S. EPA (1987)
Tetrachloroethylene	0.098	(2); Stephan et al. (1985); Suter and Tsao (1996)
Toluene	0.0098	(2); Stephan et al. (1985); Suter and Tsao (1996)
1,1,1-Trichloroethane	0.011	(2); Stephan et al. (1985); Suter and Tsao (1996)
Trichloroethylene	0.047	(2); Stephan et al. (1985); Suter and Tsao (1996)
All other constituents	No data	—

(1) U.S. Environmental Protection Agency. Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities, Peer Review Draft, November, 1999. Appendix E, Toxicity Reference Values, Screening Level Ecological Risk Assessment Protocol, August 1999.
http://www.epa.gov/epaoswer/hazwaste/combust/eco-risk/volume3/appx-e.pdf
(2) U.S. Environmental Protection Agency. Data Collection for the Hazardous Waste Identification Rule. Section 14.0 Ecological Benchmarks. October 1999.
http://www.epa.gov/epaoswer/hazwaste/id/hwirwste/pdf/risk/data/s0044.pdf
References cited in these two reports are as follows:
Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman, and W.A. Brungs. 1985. *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses.* PB85-227049. National Technical Information Service, Springfield, VA.
Suter, II, G.W., and C. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota*: *1996 Revision.*
U.S. Environmental Protection Agency. Quality Criteria for Water — Update #2. EPA 440/5-86-001. Office of Water Regulations and Standards. May 1987.

Assumptions regarding the typical size and flow rate of a small stream used in this analysis were taken directly from EPA's analysis for the paint production wastes proposed rule (EPA, Risk Assessment Technical Background Document for the Paint and Coatings Hazardous Waste Listing Determination, January 2001) For modeling purposes, the stream is shaped as a rectangle 5.5 m wide, a width typical of a third-order fishable stream (van der Leeden et al., 1990). A third-order stream refers to a type of stream segment classification. In this classification scheme, a first-order stream segment is one with no tributaries. That is, a first-order stream segment receives all of its flow from runoff from the surrounding watershed soils. A second-order stream segment is produced when two first-order stream segments come together. A third-order stream segment occurs when two second-order segments come together. The third-order steam segment, therefore, has the combined flow of at least two second-order stream segments. The third-order stream was selected because it reasonably represents the smallest body of water that would routinely support recreational fishing of consumable fish. The stream segment modeled in this assessment is assumed to be homogeneously mixed with a depth of 0.21 m (including water column and benthic sediment)

and a flow rate/velocity of 0.5 m/s (van der Leeden et al., 1990). A stream with these dimensions, therefore, has a flow rate of 49,896 m^3/day.

The quantity of leachate generated from the modeled landfill is calculated from the landfill area and the infiltration rate. As discussed previously in this report, highest human health risks were found when using a landfill with an area of 8,094 m^2 and an infiltration rate of 0.397 m/year (i.e., a small landfill in Houston Texas) (EPA 1999). This is a total leachate generation rate of 9.2 m^3/day. The ratio of the stream flow to the landfill leachate flow is 5,400, assuming that the entire landfill leachate quantity enters the stream. This is much larger than the dilution-attenuation factor of 27 used in the analysis for human health risks from drinking water wells and shows that much greater dilution results from a stream.

The benchmarks of Table 18 were compared to the simulated surface water concentration, calculated from the landfill loading rates identified for each constituent in Table 17 (assuming no centrifuging). Results are presented in Table 19. Table 19 lists each constituent, its ecological benchmark (from Table 18), and the simulated surface water concentration calculated assuming no pre-centrifuging of solvent-contaminated industrial wipes (note that assuming centrifuging of the solvent-contaminated industrial wipes prior to landfilling would result in even lower surface water concentrations). For each constituent, the simulated surface water concentrations are less than the corresponding ecological benchmark. Based on this analysis, EPA believes that none of these evaluated constituents would pose adverse ecological risks from the disposal of solvent-contaminated industrial wipes in municipal solid waste landfills.

Table 19
Ecological Screening Results for Solvent-Contaminated Industrial Wipes

Constituent Name	Concentration, mg/L		Conclusion
	Aquatic Benchmark[a]	Surface Water, without pre-Centrifuging[b]	
Acetone	1.5	0.02	No eco risk

Table 19
Ecological Screening Results for Solvent-Contaminated Industrial Wipes

Constituent Name	Concentration, mg/L		Conclusion
	Aquatic Benchmark[a]	Surface Water, without pre-Centrifuging[b]	
Benzene	0.13	0.003	No eco risk
Carbon disulfide	0.00092	0.0004	No eco risk
Chlorobenzene	0.064	0.00003	No eco risk
Methylene chloride	2.2	0.02	No eco risk
Nitrobenzene	0.27	0.002	No eco risk
Tetrachloroethylene	0.098	0.0001	No eco risk
Toluene	0.0098	0.0004	No eco risk
1,1,1-Trichloroethane	0.011	0.0003	No eco risk
Trichloroethylene	0.047	0.00002	No eco risk
All other constituents	No data	—	No data

[a] Aquatic benchmarks are presented in Table 18.
[b] Surface water concentrations calculated by combining EPA (1999) results with solvent loading and centrifuging assumptions described elsewhere for the human health risk assessment.

V.D. *Assessing Risks from the Combustion of Disposables*

EPA's analysis of possible risks from the combustion of disposables in a municipal waste combustor addressed the following questions:

- Of the quantity of solvent entering the MWC, how much of it remains unburned in the residual ash?
- Would this residual quantity in the ash present a potential risk when disposed in a landfill? Would it meet numerical land disposal restrictions (LDRs) and TC limits?

At the same time, the scope of the analysis was limited to potential risks from the ash only and did not address questions such as the following:

- Would there be any incremental risks from unburned constituents in stack emissions?
- Would the loadings contribute to dioxin/furan formation or other undesirable effects?

The general approach to answering the above questions is as follows:

1. Estimate how much (e.g., kg/day) contaminant is sent to a MWC.

2. Estimate how much of each contaminant is destroyed (or at least volatilized from the waste so it is not present in the ash). Also, estimate the size of a MWC and make assumptions regarding how many MWCs would send their ash to a single landfill.

3. Calculate how much contaminant remains in the ash. Compare these estimates to the risk loading thresholds calculated in section V.B.1 to conclude if the quantity of residual solvent in the ash would be greater than or less than the quantity that may pose a risk. Also evaluate these levels against TC and LDR standards.

4. Identify what high-end assumptions were used, as well as the uncertainties and limitations of the analysis.

5. Based on this information, make conclusions regarding the potential risks from combusting disposable industrial wipes.

As described below, the analysis uses several conservative assumptions. Therefore, the analysis can be characterized as a screening level analysis.

V.D.1. *What Quantities of Solvent Are Expected to be Sent to a MWC?*

The first step of the analysis is to estimate the quantity of each constituent that is present in wipes sent to a MWC. Many of the same assumptions made in section V.B. for disposables in landfills are relevant to the MWC analysis as well. Discussed below are additional assumptions used to specifically apply to the MWC analysis.

There are 132 MWCs operating in the United States (EPA 1997b). EPA used this number to obtain a nationwide average.

Due to the relatively small numbers of MWCs (132) and the relatively large number of landfills (over 2,000), each of the MWC facilities would be expected to dispose of its ash in a different landfill. However, to apply an additional conservative factor, EPA assumed that there could be localized effects such that a large number of MWC units (5 times such a national average) use a single landfill.

EPA also assumed that a constituent would be destroyed to 0.01 percent of its initial loading. The basis for this assumption is presented in section V.D.2.

Using these data and assumptions, EPA calculated the quantity of contaminant being sent to a individual MWC to be as follows:

1,009 million	*number of disposables used by LQGs and SQGs*
× 0.35	*fraction with F-listed constituents*
× [1-0.78]	*fraction combusting (rather than landfilling) disposable industrial wipes*
× 0.1 or 0.5	*fraction using given constituent*
× 0.1 to 0.51	*fraction of constituent in solvent (based on arithmetic average concentration)*
× [(0.049 ×	*fraction of disposables used by printers*
25) +	*grams of solvent per wipe for a printer*
(0.951 ×	*fraction of disposables used by non-printers*
12.5)]	*grams of solvent per wipe for a non-printer*
× 5	*localized concentration of generators above national average*
/ 350	*days per year that landfill operates*
/ 132	*number of MWCs nationwide*
x 0.0001	*99.99% destruction*
0.0003 to 0.003	*kg/day loading to landfill, depending on the containment*

V.D.2. *What Are the Properties of a Municipal Waste Combustion Unit?*

Two properties of a MWC are important for these calculations: its size and its destruction efficiency. Size is used in estimating the quantity of ash generated. Destruction efficiency is used for identifying how much of the incoming solvent would be destroyed by the combustion process, and for estimating whether the resulting calculated concentrations of contaminants in the ash would exceed TC or LDR levels.

Estimating the Size of a MWC

The data from EPA's Municipal Solid Waste Factbook (1997b) helped estimate the number and size of MWCs in the United States. It indicates that there are 132 MWCs with a total capacity of 111,149 tons per day, for an average capacity of 842 tons per day. To be conservative, this analysis assumes a small combustor (the 10th percentile from the population of MWCs reported in the data) with a capacity of 72.3 tons per day (65,600 kg/day). It assumes this combustor operates at 90 percent of capacity (based on capacity utilization for MWCs as a whole). Thus, the total quantity of waste combusted by this small MWC is 59,000 kg trash per day (65,600 × 0.9).

The assumption of a small MWC unit is conservative because it generates a smaller quantity of ash in which any residual solvent is contained. In effect, a smaller quantity of ash will concentrate the solvent. For this analysis, a 75 percent weight reduction of the waste is assumed (i.e., the quantity of ash generated is 25 percent of the feed, so 59,000 kg/day x 0.25 = 15,000 kg/day). Note that the size of the MWC unit, in this case, has no effect on the quantity of solvent present in wipes entering the unit. Even by assuming a smaller than average MWC, solvent-contaminated industrial wipes would comprise a very small percentage of a unit's total feed.

Fate of Organics in a MWC

A brief literature search was conducted to identify the fate of volatile constituents in MWCs. Most of the literature regarding organics focuses on dioxin, polychlorinated biphenyls (PCBs), and similar compounds, which are of limited use in this analysis. However, three references were found to be relevant for estimating destruction of solvent constituents. These analyses indicate that the quantity of contaminant in stack air compared to the feed is at least 99.99 percent less, that there is even less contaminant in the ash, and organic contaminants that are present might be the result of formation from other non-solvent materials rather than as unreacted raw MSW feed. Based on this information, EPA makes a conservative estimate that 99.99 percent of the incoming contaminant is destroyed with the remainder staying on the ash.[23] This is conservative for the following reasons:

- *Destruction of trichlorofluoromethane is at least 99.998 percent in a MWC.* The average destruction of trichlorofluoromethane (CFC-11) was found to be 99.998 percent in a full-scale municipal solid waste incinerator in Germany. This is based on the incineration of known amounts of solid polyurethane foam, which contain CFC-11. In this case, destruction is based on comparisons of exhaust gas composition to the feed. Similar (slightly higher) destruction results were found at a test facility intended to simulate MWC conditions (Rittemeyer et al., 1994). Ash concentrations were not measured. Similar investigations of other F001 through F005 solvent compounds were not located, but similar destruction equal to or greater than 99.99 percent were assumed for the remaining constituents based on the results for CFC-11.

- *Any organics that are not destroyed will favorably partition to exhaust air rather than to ash.* One source measured PCBs, chlorobenzenes, and chlorophenols (as total levels of all of these components) at two full-scale MWCs. At one facility, the quantities emitted in exhaust air ranged from 43 to 92 grams/day, the quantity discharged in ash residue was 2 grams/day, and the quantities in the feed ranged from 149 to 940 grams/day. Similar trends were evident from the second facility (Ozvacic et al., 1985). Similar partitioning (at least 20:1 gas to ash) is expected for the solvent compounds, since some are represented by these compound classes but most are even more volatile, which would decrease the quantity present in the ash compared to the exhaust air.

- *Any organic compounds present in the ash or exhaust gas (e.g., a limited subset of solvent compounds such as chlorobenzenes) may be the result of products of incomplete combustion, rather than uncombusted feed.* In one test using a bench-scale unit, MSW incinerator feed was spiked with a known amount of a

[23] As used here, destruction compares the composition of the exiting ash to the composition of the incoming municipal solid waste. For comparison, hazardous waste combustors require 99.99 percent destruction, when comparing the composition of the exiting air to the composition of the incoming waste. Because the constituents of concern are largely volatile, larger quantities of the unreacted constituent are expected to be present in exhaust gas rather than in ash residue.

tetrachlorinated phenol isomer. Other chlorinated phenol isomers were present in the exhaust gas, but this particular isomer was present at much lower levels (Kanters and Louw, 1994). Therefore, the presence of solvent components in ash or exhaust gas may be the result of their formation in the MWC, rather than as wholly unreacted MSW feed.

V.D.3. *What Are the Resulting Risk Estimates and LDR/TC Results?*

EPA used the results of sections V.D.1 and V.D.2 to estimate contaminant loadings to a MWC for the 30 F-listed solvents. The findings are shown in Table 20 and are summarized as follows:

- TC limits. Nine of the 30 contaminants are TC constituents. These limits are expressed as milligram contaminant per liter of waste extract. The TC limits range from 0.5 mg/L (benzene) to 200 mg/L (methyl ethyl ketone). Based on the data in Table 20, the quantity of uncombusted solvent ranges from about 0.0003 to 0.003 kg/day. With an ash generation rate of 15,000 kg/day (identified above), the concentration range of the solvent contaminants in the ash range from about 0.02 to 0.2 mg/kg. The ash would not be expected to exhibit the TC for these constituents because even assuming that the entire quantity of solvent leaches from the ash would result in leachate concentrations well below their respective TC limits. (As part of the calculations, 20 liters of extract are generated per kilogram of waste, based on the Toxicity Characteristic Leaching Procedure (TCLP) protocol).

- LDR treatment standards. Of the 30 contaminants, all but three have numerical treatment standards. Most of these have limits based on total levels; LDR limits range from 2.6 to 170 mg/kg. A few have limits based on TCLP levels; in these cases LDR limits range from 0.75 to 4.8 mg/L. In each case the calculated concentrations in the ash (0.0003 to 0.003 mg/kg) are well below these LDR levels.

- Risk loading thresholds. Risk loading thresholds, which identify the maximum quantity of solvent that can be disposed in a landfill and not present a risk, were identified in Table 15 for all 30 contaminants, based on a hazard quotient of 1 or cancer risk of 10^{-5} for a child receptor from multimedia exposure. The loading rate of contaminant in ash is less than the risk loading threshold for each constituent, indicating that none of the contaminants present a risk.

Table 20
Evaluation of Disposable Solvent-Contaminated Industrial Wipes for MWC

CAS No.	Constituent (RCRA Waste Codes)	TC Limit, mg/L	LDR Limit	Risk Loading Threshold (kg/d, per landfill)[a]	Loading (kg/day, per landfill)	Conclusion

Table 20
Evaluation of Disposable Solvent-Contaminated Industrial Wipes for MWC

CAS No.	Constituent (RCRA Waste Codes)	TC Limit, mg/L	LDR Limit	Risk Loading Threshold (kg/d, per landfill)[a]	Loading (kg/day, per landfill)	Conclusion
67-64-1	Acetone (F003)	NA[b]	160 mg/kg	1.73	0.0013	Acceptable
71-36-3	Butanol (F003)	NA	2.6 mg/kg	1.61	0.0006	Acceptable
75-15-0	Carbon disulfide (F005)	NA	4.8 mg/L TCLP	0.62	0.0003	Acceptable
108-90-7	Chlorobenzene (F002) (D021)	100	6 mg/kg	0.36	0.0003	Acceptable
108-94-1	Cyclohexanone (F003)	NA	CMBST[c]	64.55	0.0006	Acceptable
1319-77-3	Cresols (F004) (D023) (D024) (D025) (D026)	200	5.6 mg/kg	0.41	0.0003	Acceptable
75-71-8	Dichlorodifluoromethane (F001)	NA	NA	2.16	0.0003	Acceptable
95-50-1	1,2-Dichlorobenzene (F002)	NA	6 mg/kg	12.84	0.0003	Acceptable
141-78-6	Ethyl acetate (F003)	NA	33 mg/kg	16.17	0.0007	Acceptable
100-41-4	Ethyl benzene (F003)	NA	10 mg/kg	11.95	0.0006	Acceptable
60-29-7	Ethyl ether (F003)	NA	160 mg/kg	4.30	0.0003	Acceptable
110-80-5	2-Ethoxyethanol (F005)	NA	NA	3.82	0.0003	Acceptable
78-83-1	Isobutyl alcohol (F005)	NA	170 mg/kg	4.31	0.0006	Acceptable
67-56-1	Methanol (F003)	NA	0.75 mg/L TCLP	5.90	0.0009	Acceptable
78-93-3	Methyl ethyl ketone (F005) (D035)	200	36 mg/kg	0.32	0.0011	Acceptable
108-10-1	Methyl isobutyl ketone (F003)	NA	33 mg/kg	0.03	0.0003	Acceptable
98-95-3	Nitrobenzene (F004)	2	14 mg/kg	0.043	0.0003	Acceptable
110-86-1	Pyridine (F005) (D038)	5	16 mg/kg	0.006	0.0003	Acceptable
127-18-4	Tetrachloroethylene (F002) (D039)	0.7	6 mg/kg	5.83	0.0013	Acceptable
108-88-3	Toluene (F005)	NA	10 mg/kg	2.14	0.0015	Acceptable
71-55-6	1,1,1-Trichloroethane (F002)	NA	6 mg/kg	15.81	0.0026	Acceptable

Table 20
Evaluation of Disposable Solvent-Contaminated Industrial Wipes for MWC

CAS No.	Constituent (RCRA Waste Codes)	TC Limit, mg/L	LDR Limit	Risk Loading Threshold (kg/d, per landfill)[a]	Loading (kg/day, per landfill)	Conclusion
76-13-1	1,1,2-Trichlorotrifluoroethane (F002)	NA	30 mg/kg	403.37	0.0015	Acceptable
75-69-4	Trichlorofluoromethane (F002)	NA	30 mg/kg	16.05	0.0010	Acceptable
1330-20-7	Xylenes (total) (F003)	NA	30 mg/kg	6.18	0.0006	Acceptable
Carcinogens						
71-43-2	Benzene (F005) (D018)	0.5	10 mg/kg	0.24	0.0003	Acceptable
56-23-5	Carbon tetrachloride (F001) (D019)	0.5	6 mg/kg	3.02	0.0003	Acceptable
75-09-2	Methylene chloride (F002)	NA	30 mg/kg	0.39	0.0028	Acceptable
79-46-9	2-Nitropropane (F005)	NA	30 mg/kg	0.0033	0.0003	Acceptable
79-01-6	Trichloroethylene (F002) (D040)	0.5	6 mg/kg	27.66	0.0003	Acceptable
79-00-5	1,1,2-Trichloroethane (F002)	NA	6 mg/kg	0.83	0.0003	Acceptable

[a] Risk loading threshold shows disposal rate that results in an HQ=1 or carcinogenic risk = 10^{-5}.
[b] NA = No applicable limit.
[c] LDR limit of CMBST is technology-based, requiring combustion as the treatment standard without a specific numeric limit. This requirement, in part, assumes a minimum 99.99% destruction for hazardous waste.

V.D.4. *Analysis of Results*

The results indicate that F-listed constituents in MWC ash are expected to be destroyed in a MWC unit sufficient to meet existing LDR treatment standards and TC limits.[24] All of the 30 F-listed constituents would clearly be sufficiently destroyed such that any residual contaminant remaining in the ash would present negligible risk.

These conclusions are limited to the effects of the contaminants on the ash. Effects on stack air and subsequent risks, including risks from uncombusted solvents, as well as any products of incomplete combustion, were not evaluated.

[24] MWC ash is not required to meet LDR treatment standards. This evaluation was conducted for comparative purposes only.

V.D.5. *What High-End Assumptions Are Related With this Risk Assessment?*

This analysis uses many of the same high-end assumptions used for the analysis for disposables in landfills presented in section V.B. The high-end assumptions used in the MWC analysis, as they relate to the loading of the contaminant to the landfill, include the following:

- No removal processes are assumed to occur prior to combustion. This includes evaporation.[25] Removal efficiencies of such processes are variable.

- It is assumed that five MWCs use the same landfill. A similar 'localized concentration' effect was used for the landfill analysis (equal to ten times the national average of landfills). While different multipliers were used for each analysis (i.e., five for MWCs and ten for disposables in landfills), they have a slightly different meaning. Based on the data used for this analysis, there are 132 MWCs and over 2,000 landfills, or a national average of less than one MWC per landfill. By assuming as many as five MWCs use the same landfill, this is actually much greater than five times the national average.

Additionally, once the contaminant enters the landfill, a number of additional high-end assumptions are associated with fate and transport. These include the following:

- The contaminants in the waste are assumed to be available for release and not irreversibly bound to the matrix.

- Use of one of four scenarios which results in the greatest receptor well concentrations (i.e., a small landfill).

- The DAF for groundwater transport was evaluated at the 95th percentile level in a Monte Carlo analysis.

The contaminant loadings to a MWC were estimated as 0.0003 to 0.003 kg/day, depending on the contaminant (from Table 20). For comparison, the loadings to a landfill were estimated as 1.13 to 10.4 kg/day, depending on the contaminant (from Table 17).

V.D.6. *What Uncertainties and Limitations Are Related With this Risk Assessment?*

This analysis assumes that a MWC would achieve 99.99 percent destruction of the organic constituents of concern. This assumption is based on the measured destruction of CFC-11 (trichlorofluoromethane), one of the 30 F-listed constituents, in a MWC. No data is available for the other constituents. The analysis also conservatively assumes that the unreacted solvent feed would partition to the ash when information from the literature indicates otherwise. Again,

[25] As part of their petition, Kimberly-Clark submitted data showing the evaporation rates of certain solvents from disposable industrial wipes. SAIC (1997) also presents data regarding evaporation rates under a variety of conditions.

however, the literature does not provide partitioning information for all of the F-listed solvents.

EPA also did not assess whether certain compounds are actually formed during the combustion process as products of incomplete combustion. For example, dioxins and furans, as well as their precursors, are formed during the combustion process rather than present as incoming feed. However, there is no information to indicate what role, if any, these solvent constituents have on dioxin/furan formation.

Additional uncertainties and limitations are similar or identical to those discussed for the landfill analysis in section V.B. These include the following:

- Only compounds identified as the basis for listing F001 to F005 were considered in each analysis (e.g., co-contaminants such as metals, and other compounds that could be present in solvents were not considered).

- Negligible amounts of the constituent are present in the rest of the solid waste sent to a MWC. Therefore, it does not account for the potential introduction of the constituent by CESQGs and from household hazardous waste.

V.D.7. *Was the Approach for MWCs Externally Reviewed?*

The derivation of the risk loading thresholds for this analysis are identical to that used for the landfill analysis described in section V.B. The peer review evaluation results for this portion of the risk screening are applicable here. EPA also presented a draft of this analysis to the Integrated Waste Services Association (IWSA).

IWSA stated that the analysis was extremely conservative and supported conclusions that generated ash would not pose risks for the majority of contaminants. However, they also stated that ash testing has not detected volatile organic compounds and that semivolatile organic compounds, when found, do not leach. Additionally, they supported an even greater destruction limit than 99.99 percent. The Association contends that the inclusion of these observations would support a conclusion that all solvent-contaminated industrial wipes can be safely managed in a MWC.

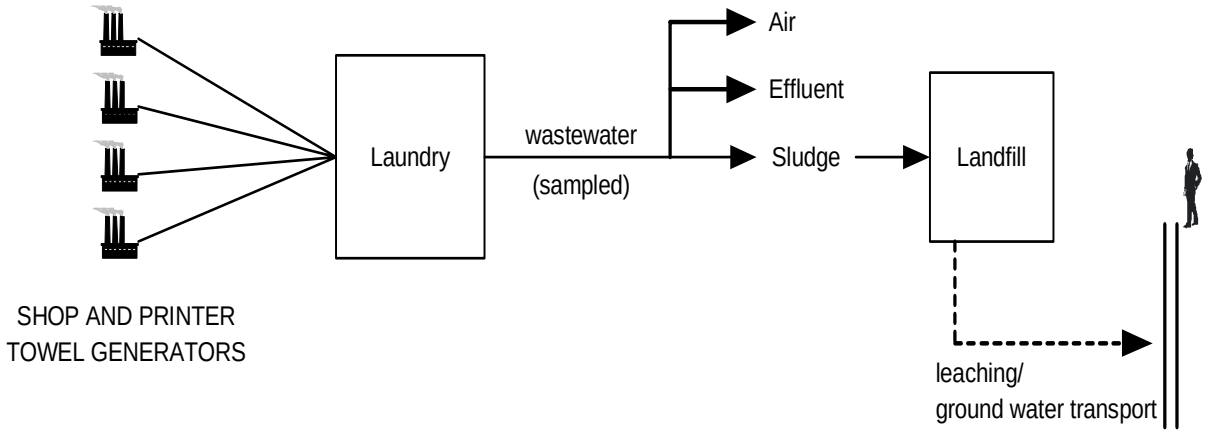
EPA notes that this risk screening analysis did not identify any potential risks from solvents in residual ash. Even if the analysis was made less conservative, based on IWSA's concerns, the results of the analysis would not change.

V.D.8 *Recommendations*

For municipal waste combustion units that accept solvent-contaminated industrial wipes, EPA is proposing to allow the generated municipal waste combustion ash to be disposed of in municipal waste landfills.

V.E. *Assessing Risks from the Laundering of Reusable Industrial Wipes*

Figure 1: Fate of Solvent Components in Reusable Solvent-Contaminated Wipes When Washed



V.E.1. *How Can Solvents Enter the Environment from Reusable Industrial Wipes?*

EPA proposed effluent guidelines for the industrial laundry industry (62 *FR* 66182, December 17, 1997). EPA subsequently finalized a decision not to promulgate effluent guidelines for this industry (64 *FR* 45071; August 18, 1999). For the proposed rule, EPA collected extensive information regarding the industrial laundry industry, types of items accepted, wastewater treatment technologies, and wastewater discharge characteristics. The data presented in this section highlights the findings of this work as it relates to risks from the laundering of wipes, as well as further investigations concerning potential risks from sludge.

Potential risks from laundering solvent-contaminated industrial wipes result from the following operations (see Figure 1):

- Storage. Oily materials are a potential source of fuel; in conjunction with sufficient air and heat a fire may result. Additionally, the presence of free liquids creates additional fuel and risk. To discourage free liquids in reusable wipes, the Uniform & Textile Service Association (UTSA) has developed management guidelines encouraging generators to implement procedures to minimize free liquids and many states require that wipes sent to laundries not contain free liquids. Additionally, based on data collected in 1994 for the Agency's effluent guidelines rulemaking effort, most laundries at that time rejected articles with free liquids.

- Effluent. All industrial laundries discharge to a municipal treatment facility (i.e., a publicly owned treatment works (POTW)), which collects and further treats waste waters from industrial, commercial, and residential sources prior to discharge. Contaminants from industrial wipes, therefore, impact the environment following a complex path of pretreatment at the facility followed by centralized treatment at the POTW.

- Solid wastes. Industrial wipes, including solvent-contaminated industrial wipes,

contribute a significant amount of contaminants to a laundry's pretreatment system. To control these pollutants prior to POTW discharge, laundries conduct treatment practices such as oil separation, dissolved air flotation, or conduct no treatment at all. The generated solids are managed as solid wastes using management methods such as landfilling or energy recovery.

- Air risks. Although the potential for air emissions is always present for volatile compounds, very little data regarding this pathway are available. The potential risks and loadings are greatest where the concentration of hydrocarbons are highest (i.e., during wipe storage, and at oil removal points in the laundry's pretreatment system). As shown later in this section, industrial laundries should not meet the 25,000 kg per year threshold of a major source.

For this assessment, EPA only considered potential risks resulting from the disposal of industrial laundry sludge in a municipal solid waste landfill.

V.E.2. *What Quantity of Solvent Is Expected to be Present in Industrial Laundry Sludge?*

Figure 1 shows a generalized diagram of how solvent components present in sludge from industrial laundries can impact human health and the environment. Multiple generators are assumed to generate industrial wipes and send these materials to an industrial laundry. Some of these wipes contain F001 to F005 solvents; the laundry cleans these (and other) materials. When wipes are laundered, the contaminants present in the wipes are removed and transferred to air, water, or solid media. When the sludge is disposed, the contaminants in them can enter the landfill leachate and be transported to a receptor.

Risks from the landfilling of industrial laundry sludge are evaluated here using the following approach:

- The disposal of industrial laundry sludge was considered alone, without consideration of disposable industrial wipes in the same landfill (i.e., additional sources of contaminants).

- Two different laundry sizes were used as calculation inputs to determine if sludge generated from such 'model' facilities would pose a risk when landfilled: an average and a large laundry. It was estimated that an average laundry would wash 270,000 pounds of printer wipes and 260,000 pounds of shop wipes per year while a few large laundries can wash up to 2,700,000 pounds of printer wipes and 2,600,000 pounds of shop wipes per year. Each size laundry was assumed to accept the same types of materials such that their washwater and sludge composition characteristics were the same.

Data characterizing laundry sludges from the washing of printer or shop wipes are not available for this analysis. As a result, the hazardous chemical sludge content was estimated from wastewater characterization. As with other analyses conducted in this report, EPA considered only the compounds that form the definition of the F001 through F005 solvent listing (i.e., other non-

listed solvents and co-contaminants are not considered).

V.E.2.a. Office of Water Data

EPA's Office of Water (OW) conducted sampling at numerous industrial laundries as part of effluent guidelines development for the 1997 proposed rule. The supporting record includes one sample of washwater generated from the washing of printer wipes from each of three different industrial laundries. This is washwater directly from the washer with no pretreatment or dilution. The highest detected concentration from the three samples was used in subsequent calculations. EPA does not consider this a high-end parameter. EPA has noted the extreme variability of solvent use and therefore is not confident that its three data points for characterizing laundry washwater are representative. To account for this uncertainty, EPA selected the maximum concentration. Because sludge samples were not collected, an air/water/solid partitioning model (WATER8) was used to estimate sludge loadings.

Only 11 of the 30 F-list constituents were detected in one or more of these samples. The remaining constituents were either not detected or not analyzed, depending on the constituent. The 11 chemicals detected are presented in Table 21.

Table 21
Constituents Detected in OW Sampling

The chemicals analyzed in the washwater samples were...	The maximum concentration found in any one sample was (mg/L)...	The average concentration of the three samples was (mg/L)...	The results of the 1996 Printer Towel survey indicated...
Acetone	96.6	49.7	Used by 27% of printers
Chlorobenzene	0.30	0.467 [a]	–
Ethylbenzene	29.24	13.2	–
Methylene chloride	1.54	0.614	–
Methyl ethyl ketone	2.24	3.09 [a]	Used by 18% of printers
Methyl isobutyl ketone	0.72	2.07 [a]	–
Tetrachloroethylene	6.16	3.92	–
Toluene	33.24	20.5	Used by 20% of printers
1,1,1-Trichloroethane	8.26	4.5	–
Trichloroethylene	0.328	0.476 [a]	–
Xylenes	102.7	35.9	Used by 20% of printers
Remaining F-list constituents	Either not detected in any of the three samples, or were not analyzed.		

[a] The average concentration is sometimes higher than the maximum concentration. This is because the detection

limit of non-detect concentrations was used in calculating the average concentrations. The detection limits are sometimes greater than the detected values.

In calculations, EPA used the maximum concentrations as input to a partitioning model, WATER8. Using this model, only a portion of the solvent in the wastewater was assumed to partition to the sludge. Calculations were conducted with process assumptions that included the following:

- Volatility reduces due to surfactant. The result is that less chemical partitions to the air and more chemical partitions to water and sludge. The presence of a surfactant was suggested during the effluent guidelines public comment period as an assumption yielding a more realistic scenario.

- Wastewater treatment included commonly used oil/water separation and settling. The analysis assumes that a less common technology, dissolved air flotation, is not present. This is a central tendency assumption because it is the most typical treatment used, and results in less solvent partitioning to the sludge than the DAF unit.

- Each pound of wipes washed is assumed to generate an average of 4.61 gallons of wastewater, with operations occurring an average of 350 days per year, based on analysis of the effluent guidelines data. These are central tendency.

As a result of using these assumptions, partitioning was found to range from 8 to 37 percent depending on the constituent. Detailed calculations of this partitioning are presented in ERG (2000).

The quantity of contaminant in the sludge is proportional (and linear) to the quantity of wipes laundered. EPA assumed that the sludge is landfilled, such that the solvent contaminants could be released to the environment in the same manner as described in section V.B., for disposable industrial wipes. EPA also assumed that each laundry uses a different landfill for disposal. Therefore, EPA calculated the quantity of wipes that would be associated with sludge contaminant levels equal to the risk loading thresholds derived in section V.B.1.

The overall approach is summarized below for an average-sized laundry. For a large laundry, only the first two values change (i.e., pounds printer wipes and pounds shop wipes washed per year):

270,000	*pounds printer wipes washed per year by average laundry*
+ (260,000	*pounds shop wipes washed per year by average laundry*
× 0.5)	*accounts for lower quantity of solvent on shop wipes*
× 0.3 to 103	*concentration of contaminant in washwater, mg/L*
× 0.08 to 0.37	*sludge partitioning without DAF (constituent specific, derived using WATER8 model)*
× 4.61	*gallons of water generated per pound of wipes washed*

/ 350	*days per year that landfill operates*
0.001 to 0.76	kg/day loading to landfill, depending on the contaminant

The results of these calculations are presented in section V.E.3.

V.E.2.b. Approach for Constituents Not Detected or Analyzed in OW Data

The remaining 19 contaminants were either not analyzed by OW or were not detected at the sampled facilities. A different approach was necessary to estimate risk from sludge disposal for these solvents.

The 1996 printer survey (referenced earlier) indicated that acetone, methyl ethyl ketone, toluene, and xylenes are the F-listed solvents most often used by printers. Each of these constituents is present in significant concentrations using the OW data, as shown in Table 21. It is likely that the remaining solvents would be used less often, and would be present at lower concentrations in laundry washwater.

The remaining 19 solvents were assumed to have a washwater concentration equal to 2.2 mg/L. This is the washwater concentration of methyl ethyl ketone (MEK), a frequently-used solvent by printers. Therefore, solvents used less frequently that MEK are assumed to have washwater concentrations no higher than MEK.

V.E.3. *Results*

EPA evaluated potential risks resulting from disposal of the laundry sludge alone, calculating the quantity of contaminant that would be present in the sludge from the treatment of reusable industrial wipes by 'average' sized industrial laundries. Results are presented in Table 22. As seen, only one solvent appears to pose a problem: 2-Nitropropane.

Table 22
Evaluation of Laundry Wastewater Treatment Sludges for Landfilling: Average Size Laundry

Constituent	Risk Loading Threshold (kg/d)	Solvent quantity in sludge (kg/d)	Conclusion
Pyridine (TC)	0.006	0.004	Acceptable
Nitrobenzene (TC)	0.04	0.005	Acceptable
p-Cresol (TC)	0.41	0.004	Acceptable
Acetone (OW)	1.73	0.26	Acceptable
Butanol	1.61	0.004	Acceptable
Methyl isobutyl ketone (OW)	0.03	0.002	Acceptable
Isobutyl alcohol	4.31	0.004	Acceptable
2-Ethoxyethanol	3.82	0.006	Acceptable
Ethyl ether	4.30	0.005	Acceptable
Methanol	5.90	0.004	Acceptable
Methyl ethyl ketone (OW, TC)	0.32	0.006	Acceptable
Ethyl acetate	16.17	0.004	Acceptable
Carbon disulfide	0.62	0.008	Acceptable
Tetrachloroethylene (OW, TC)	5.83	0.03	Acceptable
Chlorobenzene (OW, TC)	0.36	0.0015	Acceptable
Cyclohexanone	64.55	0.012	Acceptable
Ethyl benzene (OW)	11.95	0.21	Acceptable
Toluene (OW)	2.14	0.25	Acceptable
Dichlorodifluoromethane	2.16	0.007	Acceptable
1,1,1-Trichloroethane (OW)	15.81	0.03	Acceptable
Trichlorofluoromethane	16.05	0.007	Acceptable
1,2-Dichlorobenzene	12.84	0.004	Acceptable
Xylenes (total) (OW)	6.18	0.76	Acceptable
1,1,2-Trichlorotrifluoroethane	403	0.013	Acceptable
2-Nitropropane © - air)	0.0033	0.004	**Ineligible**
Methylene chloride (C, OW)	0.39	0.005	Acceptable
Benzene (C, TC)	0.24	0.006	Acceptable
1,1,2-Trichloroethane (C)	0.83	0.006	Acceptable
Carbon tetrachloride (C, TC)	3.02	0.007	Acceptable
Trichloroethylene (C, OW, TC)	27.66	0.001	Acceptable

EPA also evaluated potential risks resulting from disposal of the laundry sludge when generated from a large laundry. These laundries have the same characteristics as described previously, with the exception that 2.7 million pounds of printer wipes and 2.6 million pounds of shop wipes are accepted annually by one laundry. Results are presented in Table 23. For this case, six solvents appear to pose a problem: acetone, nitrobenzene, 2-nitropropane, pyridine, toluene, and xylenes.

Table 23
Evaluation of Laundry Wastewater Treatment Sludges for Landfilling: Large Laundry

Constituent	Risk Loading Threshold (kg/d)	Solvent quantity in sludge (kg/d)	Conclusion
Pyridine (TC)	0.006	0.036	**Ineligible**
Nitrobenzene (TC)	0.04	0.049	**Ineligible**
p-Cresol (TC)	0.41	0.036	Acceptable
Acetone (OW)	1.73	2.56	**Ineligible**
Butanol	1.61	0.036	Acceptable
Methyl isobutyl ketone (OW)	0.03	0.020	Acceptable
Isobutyl alcohol	4.31	0.036	Acceptable
2-Ethoxyethanol	3.82	0.058	Acceptable
Ethyl ether	4.30	0.049	Acceptable
Methanol	5.90	0.036	Acceptable
Methyl ethyl ketone (OW, TC)	0.32	0.063	Acceptable
Ethyl acetate	16.17	0.040	Acceptable
Carbon disulfide	0.62	0.080	Acceptable
Tetrachloroethylene (OW, TC)	5.83	0.30	Acceptable
Chlorobenzene (OW, TC)	0.36	0.015	Acceptable
Cyclohexanone	64.55	0.13	Acceptable
Ethyl benzene (OW)	11.95	2.14	Acceptable
Toluene (OW)	2.14	2.48	**Ineligible**
Dichlorodifluoromethane	2.16	0.071	Acceptable
1,1,1-Trichloroethane (OW)	15.81	0.26	Acceptable
Trichlorofluoromethane	16.05	0.071	Acceptable
1,2-Dichlorobenzene	12.84	0.036	Acceptable
Xylenes (total) (OW)	6.18	7.57	**Ineligible**
1,1,2-Trichlorotrifluoroethane	403	0.13	Acceptable
2-Nitropropane © - air)	0.0033	0.045	**Ineligible**
Methylene chloride (C, OW)	0.39	0.051	Acceptable
Benzene (C, TC)	0.24	0.062	Acceptable
1,1,2-Trichloroethane (C)	0.83	0.058	Acceptable
Carbon tetrachloride (C, TC)	3.02	0.071	Acceptable
Trichloroethylene (C, OW, TC)	27.66	0.010	Acceptable

V.E.4. *What High-End Assumptions Are Related With this Analysis?*

This analysis uses many of the same high-end assumptions as used for the analysis for disposables in landfills presented in section V.B. The high-end assumptions used in the laundry sludge analysis, as they relate to the loading of the contaminant to the landfill, include the following:

- In one case, EPA evaluated risks from sludge generated from a large laundry. While such facilities exist, they represent a small segment of the population. This is a high-end parameter. However, results were presented for both a central tendency (average-sized) laundry and a large laundry.

Additionally, once the contaminant enters the landfill, a number of additional high-end assumptions are associated with fate and transport. These include the following:

- The contaminants in the waste are assumed to be available for release, and not irreversibly bound to the matrix.

- Use of one of four scenarios which results in the greatest receptor well concentrations (i.e., a small landfill).

- The DAF for groundwater transport was evaluated at the 95th percentile level in a Monte Carlo analysis.

V.E.5 *What Uncertainties and Limitations Are Related With this Analysis?*

A primary area of uncertainty is sludge characterization. All evaluations were based on the projected levels of contaminant in the sludge, using OW data. There are further limitations associated with this approach.

- The analysis does not account for the range and variability of operations and sludge disposal practices at individual laundries. Such variability includes the following:

    - Differences in pretreatment practices of incoming wipes or variability in use of the three OW wastewater samples.

    - Variations in wastewater treatment system configurations and solvent removal efficiency. A more efficient system with a dissolved air flotation (DAF) unit increases solvent loadings 2 to 3 times depending on the contaminant (ERG, 2000). However, because DAF units are uncommon, results for such an analysis are not presented.

    - EPA assumes that the only source of these constituents in the sludge results from the wipes and that there are no seasonal variations in wipe generation rates or in their composition.

- In this analysis EPA assumed that a single landfill is used in managing waste from a single facility. This is a nationwide average, but ignores regional variations where some states have higher concentrations of laundries. For example, nationwide there are about 2,500 landfills ('The State of Garbage in America,' BioCycle, April 1998) and about 1,000 laundries (not all of the laundries necessarily manage shop and printer wipes) (EPA, 2000). These data indicate that there are more landfills than laundries. However, the same sources indicate that in five states (Connecticut, Delaware, Maine, Rhode Island, and Vermont), counted together, there are equal numbers of laundries and landfills (24).

- There is limited sampling data available, and only 11 constituents of interest were

detected. The remaining constituents were not available or not detected in the OW data set, however, the same series of assumption made for the constituents with OW data apply.

A second area of uncertainty is with the risk assessment itself. These uncertainties were identified in section V.B.

V.E.6. *Effects from Air Emissions*

EPA did not evaluate receptor risks from the management of solvent-contaminated industrial wipes at industrial laundries. However, EPA did identify if industrial laundries are likely to be considered 'major sources' under the Clean Air Act (CAA). One of the criteria for a major source is whether a single facility releases more than 25,000 kg (55,000 pounds) of CAA hazardous air pollutants (HAPs) per year.

Since solvents are comprised of volatile compounds, the potential for air emissions will always exist. For the proposed effluent guidelines rule for industrial laundries, EPA estimated that, as a worst-case scenario, HAPs would be emitted at a rate of 14,000 kg per year, per facility. As part of this present analysis regarding solvent-contaminated industrial wipes, EPA has estimated quantities of solvent constituent releases into the air by modeling laundry facilities using the WATER8 computer model, as described in section V.E.2.

Of the 30 constituents evaluated, 17 are HAPs.[26] The total quantity of the 17 HAPs released by a laundry with the assumptions described in this section is 500 kg per year, for a typical size laundry. For a large laundry, an estimated 5,000 kg of HAPs are estimated to be released annually. Based on this methodology, industrial laundry facilities would not be defined as a major source of pollution under the CAA since the total emissions of HAPs does not exceed the 25,000 kg (55,000 lbs.) per year threshold.

V.E.7. *Recommendations*

For industrial laundries accepting 'average' amounts of solvent-contaminated shop and printer wipes, EPA is proposing to allow the generated industrial laundry sludge to be disposed of in municipal waste landfills. This recommendation would therefore allow 2-nitropropane contaminated sludges generated by industrial laundry wastewater treatment systems to be eligible for disposal, even though the results of Table 22 suggest it may present a risk. EPA is proposing this recommendation because it has been unable to identify in data searches even one generator who uses this chemical for cleaning or degreasing operations in conjunction with reusable (or disposable) wipes.

With respect to the very few industrial laundries managing large amounts of solvent-contaminated industrial wipes, EPA again is proposing to allow industrial laundry sludge to be

[26] The HAPs are benzene, carbon disulfide, carbon tetrachloride, chlorobenzene, cresols, ethyl benzene, methanol, methyl ethyl ketone, methylene chloride, methyl isobutyl ketone, nitrobenzene, 2-nitropropane, tetrachloroethylene, 1,1,2-trichloroethane, toluene, trichloroethylene, and xylenes.

disposed of in municipal landfills. EPA is proposing this recommendation because it does not believe all generators are using F-listed solvents, particularly those not found in the Office of Water's washwater samples. This analysis assumes that all washwaters contain the same constituents and concentrations as found in OW's samples, which is not possible. In addition, EPA has found from site visits that the very large industrial laundries tend to utilize solvent extraction technologies prior to entering the laundering process–thus the amount of contaminants in the sludge should be substantially reduced.

V.F. *Damage Cases Associated with Solvent-Contaminated Industrial Wipes*

EPA investigated whether there have been damage cases involving solvent-contaminated industrial wipes (e.g., where these wipes spontaneously combusted or fires occurred involving these materials). In support of this effort, EPA searched available databases and several other sources to determine if there are damage cases or any formal documentation available on the combustibility of solvent-contaminated industrial wipes.

Based on engineering analyses and results from visits to generators, the most serious potential for environmental damage from solvent-contaminated industrial wipes is the ignition of these material, although other forms of environmental damage are possible, such as uncontrolled land disposal resulting in groundwater contamination. While the migration of solvents in the groundwater has been well-documented (see, for example, EPA's 1980 background document for listing F001 through F005 wastes as hazardous), EPA expected it would be difficult, if not impossible, to try to investigate if contamination has resulted specifically from the landfill disposal of solvent-contaminated media.

V.F.1. *What Are the Findings?*

Although many fires caused by solvent-contaminated industrial wipes are controlled and extinguished on site without assistance from emergency response personnel, other information collected found that sometimes the fires escalate and result in the entire facility being destroyed.

The U.S. Fire Administration (USFA), within the Federal Emergency Management Agency (FEMA), gathers and analyses information on the magnitude of the nation's fire problem, as well as detailed characteristics and trends. As part of this, participating local fire departments fill out Incident and Casualty reports as fires occur. These data are maintained on the National Fire Incident Reporting System (NFIRS). Currently, 40 states and the District of Columbia voluntarily participate and report NFIRS data. Nearly 14,000 out of 30,000 fire departments report NFIRS data.

In an effort to understand the extent of reported fires at industrial laundries a query was made of NFIRS for the 1993-97 time period. Below is a summary of the number of the reported incidents, total number of states where incidents were reported, and estimated dollar loss.

Year	Total Incidents	No. States w/Incidents	Est. Dollar Loss(m)
1993	186	28	$2.1
1994	154	33	$1.2
1995	158	30	$1.7
1996	131	29	$1.1
1997	106	26	$3.3

The average number of reported fires was 147. However, maybe more important has been the steady decline from a high in 1993 of 186 reported fires to 106 in 1997. Assuming only one fire occurred per facility, this represents six percent of the universe of industrial laundries. Similarly, the average estimated dollar loss of most reported fires ranges from a low of $7,792 in 1994 to $31,132 in 1997. A closer look at the data reveals that most reported fires are at the lower dollar loss range, but that a few fires with million dollar (and higher) estimated losses skew the results higher. Also, in discussions and correspondence with a few fire marshals where high dollar losses occurred, wipes were involved in the cause – primarily through the self-combustion of these materials.[27]

As discussed in the preamble to this rule, officials from the industrial laundry trade associations are very concerned about spontaneous combustion. EPA has asked for comments regarding whether generators should be allowed to use exotic solvents in conjunction with industrial wipes to send their wipes off site with free liquids to avoid the potential of self-ignited fires.

EPA also searched other available databases and the Internet, and requested information from several State agency officials and representatives from trade associations. Evidence of damage as a result of spontaneous combustion (or self-ignition) of wipes was found. Several experts contacted noted the danger of ignition of solvent-contaminated industrial wipes. However, given the small scale of most fires associated with these materials, documentation of specific instances of fire damage due primarily to spontaneous combustion of solvent-contaminated industrial wipes was not available. Additional information on fires caused by these materials may exist in local fire departments not contacted by EPA.

According to interviews with representatives from the insurance industry and states, solvent-contaminated industrial wipes do present a fire risk. However, most of the fires resulting from solvent-contaminated industrial wipes are small in scale, are easily extinguished with a fire extinguisher, and cause minimal damage. Most of the fires can be easily avoided through better management. One insurance industry representative suggested that fires may be more frequent in industrial laundries since they accept wipes from many different companies and may not be able to control the mixing of combustibles.

[27]Discussion between Captain Rob Dunham, Deputy Fire Marshal, City of Oceanside, California and Jim O'Leary on August 27, 1999; discussion between Michael Perry, Division of Fire, City of Franklin, Ohio and Jim O'Leary on September 7, 1999.

V.F.2. *Sources for Information on Environmental Damage from Solvent-Contaminated Industrial Wipes*

EPA reviewed data from numerous sources to identify evidence of environmental damage from solvent-contaminated industrial wipes. These sources included publicly available databases, conversations with officials in States and EPA Regions, fire-related trade associations, the Internet, local fire departments, and background materials in OW's docket supporting the pretreatment standards rule for industrial laundries. Each of these sources is discussed below.

Databases

Numerous databases catalogue accident and damage information. The Right-to-Know Network (http://www.rtk.net) contains several on-line databases which can be searched. The following RTK Net databases were investigated for information regarding damage cases involving solvent-contaminated industrial wipes using related search terms (e.g., industrial laundry, solvent, rags, wipes, F001-F005). The following lists the specific databases that were searched, what was looked for, and what relevant information was found, if any.

ARIP (Accidental Release Information Program)-- ARIP contains information on the causes of accidents, and particularly targets accidents that resulted in off-site consequence or environmental damage.

CERCLIS (CERCLA "Superfund" Information System)-- The database contains information on hazardous waste sites, site inspections, preliminary assessments, and remedial status.

DOCKET-- This database contains EPA Civil Court cases and Administrative Actions filed by the Department of Justice on behalf of EPA.

ERNS (Emergency Response Notification System) – ERNS compiles reports of non-routine releases of certain substances when those releases exceed a reportable quantity (RQ). This database can be searched by geographical area, discharger, and material.

FINDS (Facility Index System) – This database provides basic information on facilities regulated under a variety of EPA program areas.

PCS (Permit Control System for water permits) – This database tracks NPDES surface water permits issued under the Clean Water Act.

RCRIS (RCRA Information System) – This database contains information regarding violations, enforcement actions, and inspections at RCRA facilities.

NFIRS (National Fire Incident Reporting System) – This database compiles information about fires through reports filed to the U.S. Fire Administration from local fire departments.

BLS (Bureau of Labor Statistics) – The Bureau of Labor Statistics Internet site contains a database (http://www.osha.gov/oshstats/bls) containing information on laundry, cleaning, and garment services.

OSHA (Occupational Safety and Health information) – OSHA's Office of Statistics was contacted to search their databases.

States

Few state officials provided any information or comments on damage cases caused by solvent-contaminated industrial wipes. Information regarding damage cases from both generators and industrial laundries was generally not available as many states and EPA RCRA enforcement officials do not extensively regulate or collect information on many of these facilities.

VI. References

ERG. 2000. Mass Balance Estimation for Solvents on Soiled Printer Towels — Analysis Based on Office of Water Printer Towel Sampling Data. February 1, 2000.

Jacqueline Kanters and Robert Louw. "Chlorine Input and Output in Combustion of Municipal Solid Waste in a Lab-Scale Mini-Reactor System." Chemosphere 29(9-11), pp 1919-1925 (1994).

V. Ozvacic, G. Wong, H. Tosine, R.E. Clement, J. Osburne. "Emissions of Chlorinated Organics from Two Municipal Incinerators in Ontario." Journal of the Air Pollution Control Association 35(8), pp 849-855 (1985).

C. Rittemeyer, P. Kaese, J. Vehlow, W. Vilöhr. "Decomposition of Organohalogen Compounds in Municipal Solid Waste Incineration Plants. Part II: Co-Combustion of CFC Containing Polyurethane Foams." Chemosphere 28(8), pp 1455-1465 (1994).

SAIC. "Use and Management Practices of Solvent Contaminated Industrial Shop Towels," Final Report. December 1997.

SGIA. 1998a. Memorandum from Marcia Kinter (Screenprinting and Graphic Imaging Association International) to Jim O'Leary (EPA). February 20, 1998

SGIA. 1998b. Memorandum from Marcia Kinter (Screenprinting and Graphic Imaging Association International) to Jim O'Leary (EPA). May 4, 1998.

'The State of Garbage in America,' BioCycle. April 1998.

U.S. Environmental Protection Agency. Final Best Demonstrated Available Technology (BDAT) Background Document for Universal Standards, Volume A. July 1994

U.S. Environmental Protection Agency. Exposure Factors Handbook. August 1997a. Final Report. EPA/600/P-95/002Fa.

U.S. Environmental Protection Agency. Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category. EPA 821-R-97-007. November 1997b.

U.S. Environmental Protection Agency. Municipal Solid Waste Factbook -- Internet Version. November 1997c. <http://www.epa.gov/epaoswer/non-hw/muncpl/factbook/>

U.S. Environmental Protection Agency. Summary and Assessment of Peer Review Comments Solvent-Contaminated Towels, Rags, and Wipes. November 18, 1998.

U.S. Environmental Protection Agency. Estimating the Risk from the Disposal of Solvent-Contaminated Shop Towels and Wipes in Municipal Landfills." March 1999.

U.S. Environmental Protection Agency. Technical Development Document for the Final Action Regarding Pretreatment Standards for the Industrial Laundries Point Source Category. EPA 821-R-00-006. March 2000.

van der Leeden, F., F.L. Troise, and D.K. Todd. 1990. *The Water Encyclopedia*. 2nd edition. Chelsea, Michigan: Lewis Publishers.